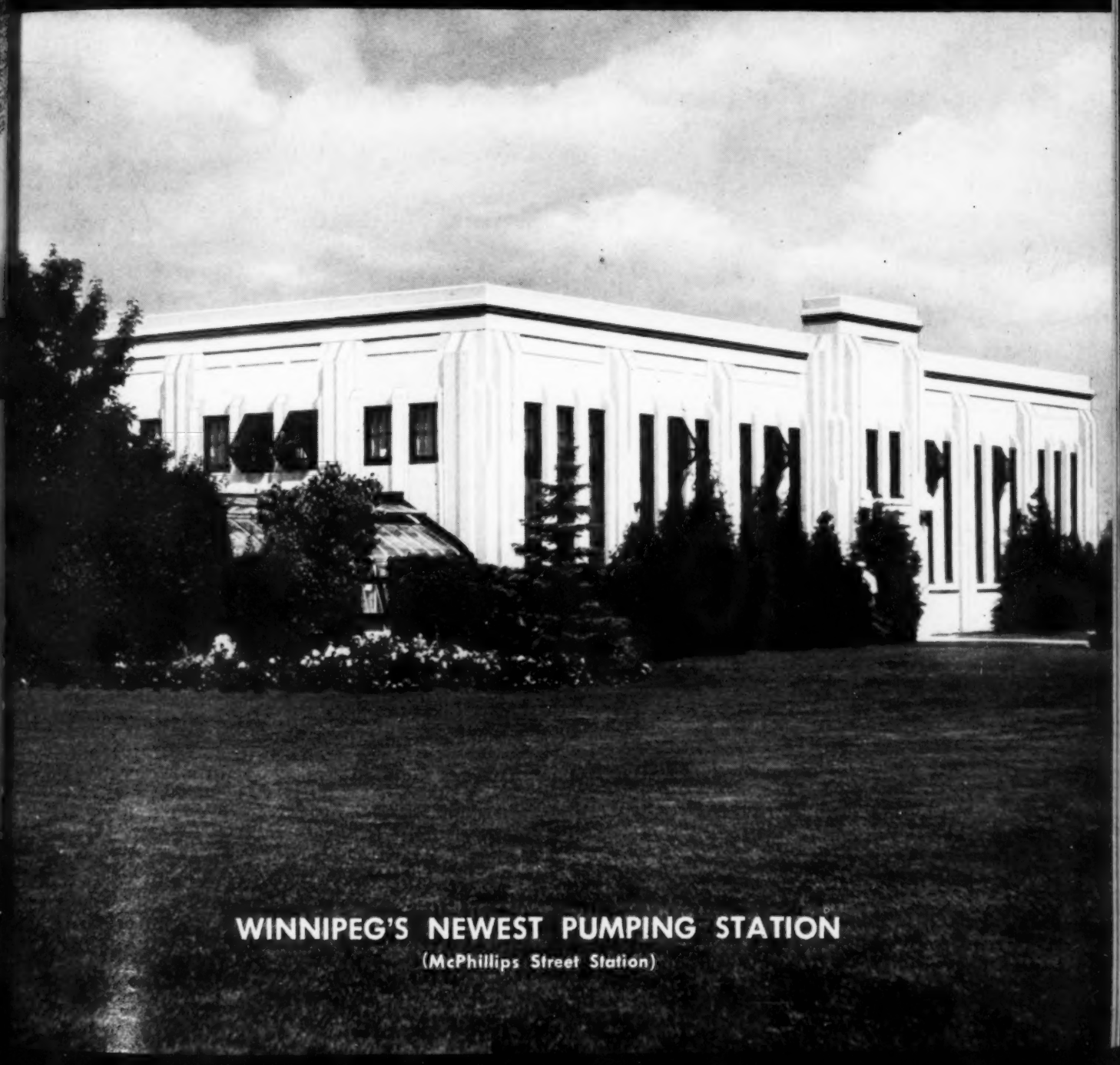
WATER & SEWAGE WORKS



WINNIPEG'S NEWEST PUMPING STATION

(McPhillips Street Station)

PENN SALT
LIQUID CHLORINE
Of the various agents for sanitizing water supplies, chlorine has proved to be the most efficacious, flexible and economical. Under certain conditions chlorine has the additional advantages of stabilizing sludge, controlling tastes and odors, aiding precipitation and prolonging disinfecting action.
Chlorine is the most widely used agent for controlling the odors of sewage. It is also useful in the prevention of sewer and manhole disintegration.
PENNSYLVANIA SALT MANUFACTURING COMPANY
Chemicals
1000 WIDENER BUILDING • PHILADELPHIA 7, PA.
NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • CINCINNATI • MINNEAPOLIS • WYANDOTTE • TACOMA
Penn Salt manufactures
LIQUID CHLORINE
for water sanitation and sewage treatment
Also
Perchloron* • Anhydrous Ammonia
Filter Alum • Ferric Chloride
Sodium Aluminate
Quaker Improved Chlorinated Lime*
Caustic Soda and other products
*Trade-mark Reg. U.S. Pat. Off.

WATER AND SEWAGE WORKS, May, 1946. Volume 93, Number 5. Published monthly by Gillette Publishing Co., 330 South Wells Street, Chicago, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, March 12, 1946, at the Post Office at Chicago, Ill., under act of March 3, 1879.

TOUGH SEWAGE PROBLEM

EFFECTIVE — LOW-COST — NUISANCE-FREE SEWAGE TREATMENT FOR SMALL COMMUNITIES

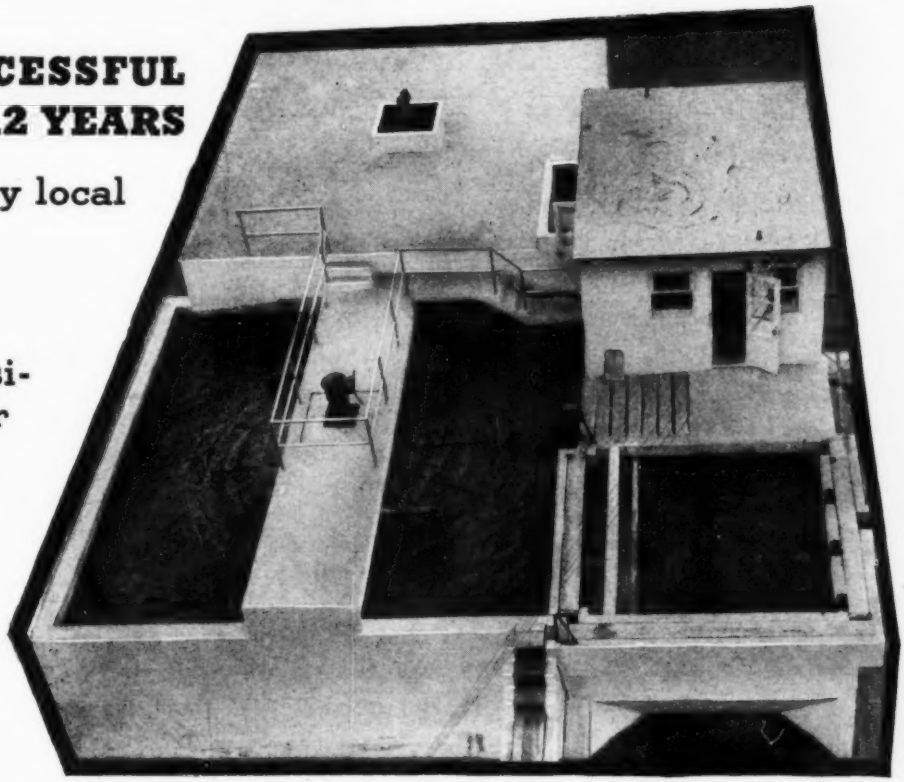
SOLVED

.....through intensive engineering application

WITH CHICAGO "PACKAGE" PLANTS
TAILORED TO REQUIREMENTS

OVER 100 IN SUCCESSFUL OPERATION LAST 12 YEARS

- Simple to operate by local man
- Low first cost
- Located close to residences without odor or fly nuisance
- Eliminates long interceptor
- Neat in appearance
- Space saving
- Produce sparkling clear effluent

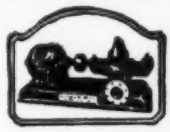


Chicago "Package" Sewage Treatment Plant at the Consolidated Vultee Aircraft Corp., Miami Springs, Florida. The primary tank is in the right foreground. Behind it is the pump house. Left foreground is the Combination Aerator-Clarifier. Aeration and clarification are performed in this single tank. Behind it is the digester.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

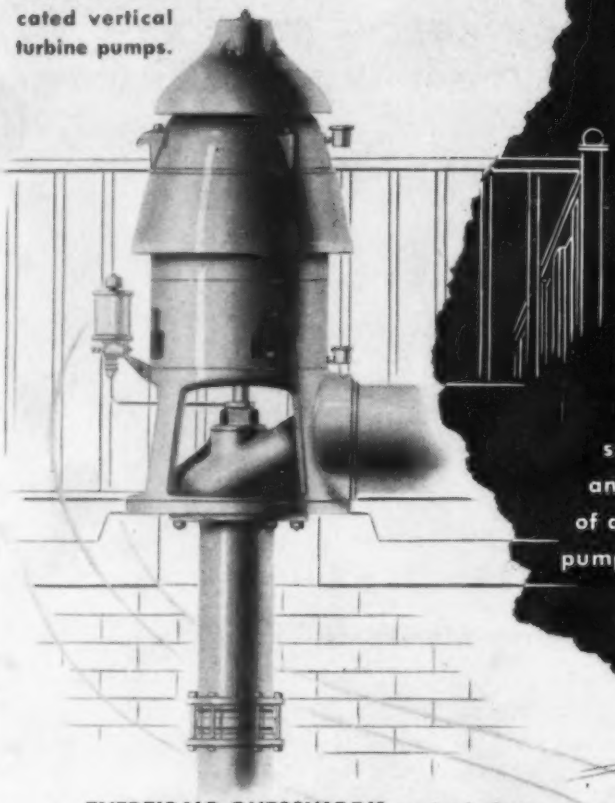
2349 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**



Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

POMONA: Water-lubricated vertical turbine pumps.

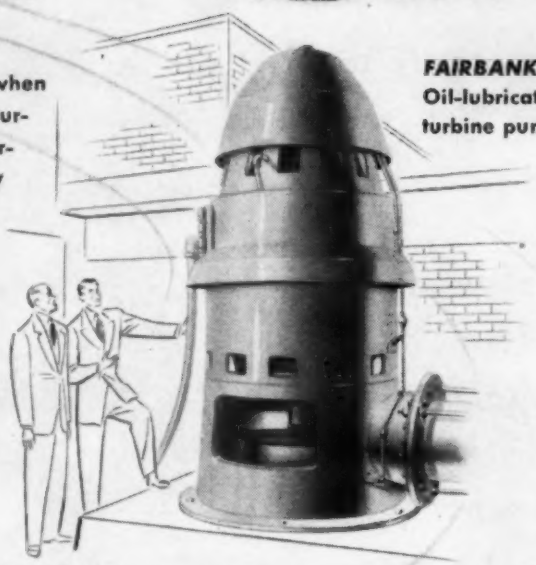


How can you tell a good Pump?

After all, what is the best way to tell a good pump? While you can compare efficiency curves, high efficiency in the test-room is no assurance of stamina on the job. Nor can performance data prove that you're getting the pump that's best for your specific liquid-moving work. *The name alone tells this story!*

Who makes it? On a good pump the name plate symbolizes manufacturing facilities, years of research and testing, trained men and intimate knowledge of all pumping requirements that back an ability to pump for you for less, through the years.

THERE'S NO GUESSWORK required when it comes to choosing the best vertical turbine pump for you. For the names of Fairbanks-Morse and Pomona identify every type and size of vertical turbine found in industry today; and these names stand unique in the pump-building world as two of the oldest, most widely respected and "depended upon" pump builders.



FAIRBANKS-MORSE: Oil-lubricated vertical turbine pumps.

GOOD PUMPS? Yes, and there are many who know these as *the best* of the vertical turbines—thousands and thousands of users who consistently report "maintenance costs nil, power costs extremely low."

REMEMBER THESE NAMES and all that is behind them when faced with a pumping problem. Then see your Pomona dealer or visit your Fairbanks-Morse branch office—the "big store" for all *good* pumps.

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • MAGNETOS • GENERATORS • MOTORS • PUMPS
SCALES • STOKERS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT

Your customers will really have to hunt for tastes and odors in your water supply if you use Aqua Nuchar Activated Carbon. That is why more than 1200 communities have used Aqua Nuchar to insure palatable water at the low average cost of two cents per capita per year.

Aqua Nuchar Activated Carbon successfully controls by *adsorption* tastes and odors characterized as earthy, woody, vegetable, bitter, aromatic, fishy, marshy, swampy, muddy, and chlorine; which may originate from decaying vegetation, algae or industrial wastes.

Order your supply of Aqua Nuchar Activated Carbon today. Warehouse stocks are available at strategic points throughout the United States.

NUCHAR — INSURES PALATABLE DRINKING WATER

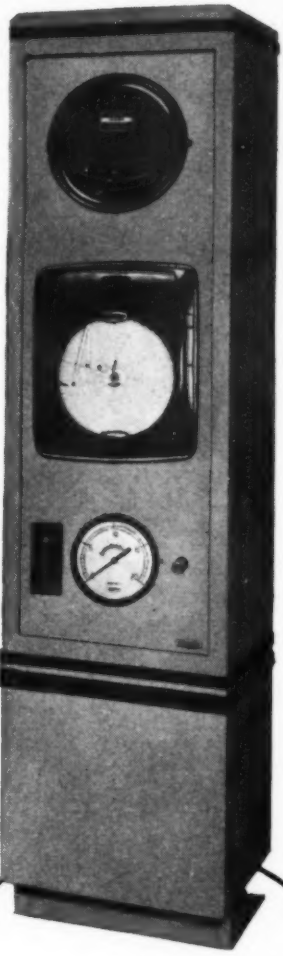
INDUSTRIAL CHEMICAL SALES

DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

230 PARK AVENUE, NEW YORK 17, N.Y. · 35 E. WACKER DRIVE, CHICAGO 1, ILLINOIS · 748 PUBLIC LEDGER BLDG., PHILADELPHIA 6, PA. · 844 LEADER BLDG., CLEVELAND 14, OHIO

Complete Automatic Control for Pumping Plants...

IN A SINGLE, COMPACT UNIT

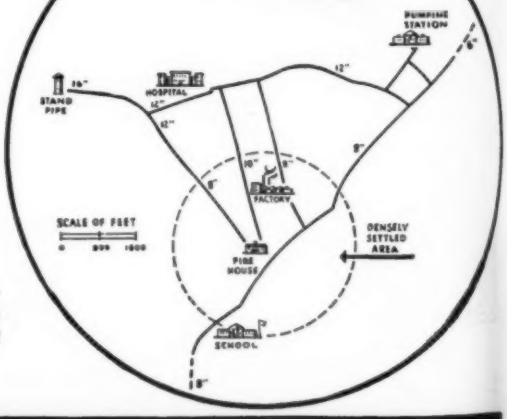


This convenient, foolproof Foxboro unit simplifies the problem of automatic control for pumping plants. It is easy and quick to install – requires no technical skill. It comes completely assembled by factory experts . . . any element of risk in the proper hook-up of instruments is avoided. Once installed, it is designed to operate at top efficiency with the least amount of attention.

This Foxboro control unit, attractively finished in gray with contrasting red bands, consists of the following better-engineered Foxboro instruments . . .

1. **Indicating Altitude Controller** . . . automatically starts and stops pumps on demand from elevated storage tank by pressure control. Also operates signal lights, proportioning pumps, or other auxiliary electric equipment.
2. **Flow Recorder (Master Meter)** with pressure pen and integrator . . . not only shows pump output and head of water, but also keeps an accurate record of these operations for day-to-day comparison and for insurance rating.
3. **Draw-Down (liquid level) Indicator** which shows water level in well.
4. **Hand Pump** for Draw-Down Indicator.
5. **Hand-Off Automatic Switch.**

In planning modern instrumentation for pumping plants, Foxboro Engineers will be pleased to furnish specifications and to cooperate with consulting or operating engineers. Descriptive literature giving complete details of this control unit will be sent on request. Write **The Foxboro Company, 228 Neponset Avenue, Foxboro, Mass., U. S. A.**



Typical water system layout controlled by Foxboro Pumping Plant Unit

See the new Foxboro Pumping Control Unit in our booth at St. Louis

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

CHEMICAL USERS' GUIDE To General Chemical Company Products for Treatment of Water, Sewage, and Industrial Wastes

PRODUCT	AVAILABLE FORMS	COMMERCIAL STRENGTH (MIN.)	SHIPPING CONTAINERS	APPLICATIONS
Aluminum Sulfate $Al_2(SO_4)_3 \cdot 14H_2O$ approx. *(Filter Alum)*	Commercial & Iron Free: Lump • Ground Powdered	17.25% Al_2O_3	Bags Barrels • Drums Bulk Carloads	Coagulant for water and sewage. Dewatering conditioner for sewage sludge. 1% Sol. pH 3.4.
Aqua Ammonia NH_4OH plus Water *(Ammonia Water)*	Colorless Liquid	26° Be. (29.4% NH_3)	Steel Drums Carboys	Used with chlorine to form chloramines for water and main disinfection.
Ammonium Aluminum Sulfate $Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$ *(Ammonia Alum) (Crystal Alum)*	Lump Nut Granular Powdered	11.2% Al_2O_3	Bags Fibre Drums	Coagulant for water. Advantageous for pressure filters. Supplies ammonia for chloramine formation. 1% Sol. pH 3.5.
Sodium Bisulfite, Anhydrous $Na_2S_2O_5$ *(ABS) (Sodium Metabisulfite)*	Powdered	97.5% $Na_2S_2O_5$ (Equiv. 65.5% SO_2)	Fibre Drums	Antichlor. Remove iron and manganese deposits from filter sand. 1% Sol. pH 4.6.
Sodium Silicate $Na_2O \cdot X(SiO_2)$ plus H_2O *(Water Glass) (Silicate of Soda)*	Viscous Liquid	38° to 52° Be. Various Ratios of $Na_2O \cdot SiO_2$	Drums Tank Cars Tank Trucks	1. Aid in floc formation. 2. Prevent red water in distribution lines. 1% Sol. pH 12.7.
Sodium Thiosulfate $Na_2S_2O_3 \cdot 5H_2O$ *(Hypo) (Sodium Hyposulfite)*	Crystals: Prismatic Rice Selected Universal Granular	99.75% $Na_2S_2O_3 \cdot 5H_2O$	Bags Barrels Fibre Drums	Antichlor. Water solution is neutral.
Sulfuric Acid H_2SO_4 plus H_2O *(Oil of Vitriol)*	Corrosive, oily liquid Various strengths	66° Be. (93.19% H_2SO_4)	Bottles Carboys Drums Tank Trucks Tank Cars	1. Reduce pH and alkalinity. 2. Regenerate carbaceous zeolites and ion exchangers.
Potassium Aluminum Sulfate $Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$ *(Potash Alum)*	Lump Nut Granular Powdered	10.7% Al_2O_3	Bags Fibre Drums	Coagulant for water. Slow, even rate of solubility desirable for solution pots. 1% Sol. pH 3.52.
Sodium Sulfite, Anhydrous Na_2SO_3 *("Sulfite")*	Granular Powdered	98.5% Na_2SO_3	Bags Fibre Drums	Weak solutions absorb oxygen readily. 1% Sol. pH 9.8.
Sodium Sulfate, Crystal $Na_2SO_4 \cdot 10H_2O$ *(Glauber's Salt)*	Crystal & Needle Cryst.	96% $Na_2SO_4 \cdot 10H_2O$	Barrels Bags Drums	Neutral Solution.
Sodium Sulfate, Anhydrous Na_2SO_4	Powdered	99.5% Na_2SO_4	Bags Barrels	Neutral Solution.
Trisodium Phosphate $Na_3PO_4 \cdot 12H_2O$ *(TSP)*	Crystal	98.5—103% $Na_3PO_4 \cdot 12H_2O$ (Equiv. 19% P_2O_5)	Bags Barrels Fibre Drums	Boiler water treatment. Cleaning compound. 1% Sol. pH 11.8-12.0.
Disodium Phosphate, Crystal $Na_2HPO_4 \cdot 12H_2O$	Crystal	98% $Na_2HPO_4 \cdot 12H_2O$ (Equiv. 19.5% P_2O_5)	Bags Barrels Fibre Drums	Boiler water. (Calcium and magnesium precipitation.) 1% Sol. pH 8.4.
Disodium Phosphate, Anhydrous Na_2HPO_4	Powdered Flake	96% Na_2HPO_4 (Equiv. 48% P_2O_5)	Same	Same as Crystal, but stronger product.
Tetrasodium Pyrophosphate, Anhydrous $Na_4P_2O_7$ *(TSPP) (Pyro)*	Powdered	98% $Na_4P_2O_7$ (Equiv. 52% $5P_2O_5$)	Bags Barrels Fibre Drums	Stabilization of water. Used for P_2O_5 content in boiler waters. 1% Sol. pH 10.1.
Sodium Fluoride NaF *(Fluoride)*	Powdered (white or blue colored: Nile Blue) Light or dense	90% and 95% NaF	Bags Barrels Fibre Drums	Fluorination of water supplies. (For information, consult with local and state health officials.)

FOR THE LABORATORY: Baker & Adamson Laboratory Reagents

★ As a major source of Basic Chemicals for American Industry for almost half a century, General Chemical Company has long provided a wide range of products for use in the treatment of water, sewage, and industrial wastes. Pertinent data on such chemicals are compiled in this Chemical Users' Guide for your ready reference.

For full information, contact nearest General Chemical Sales & Technical Service office. Remember—when you make General Chemical your source of supply—these key chemicals so vital to your operations are always readily available from conveniently located plants and warehouses throughout the nation!

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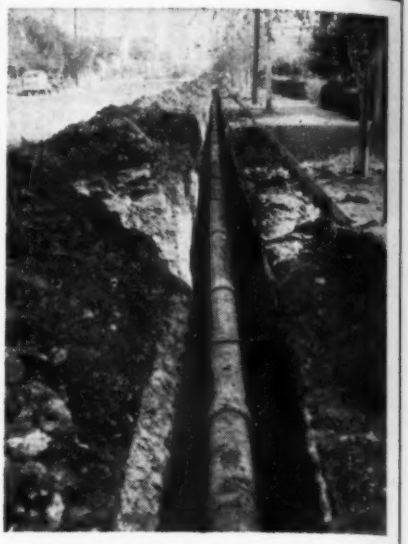
In Wisconsin: General Chemical Wisconsin Corporation, Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited Montreal • Toronto • Vancouver

UNDER CITY STREETS, Transite saves by permitting narrower trenches, reducing disturbance to pavement. Fast assembly minimizes traffic tie-ups.

IN AGGRESSIVE SOILS, Transite guards against destructive corrosion. Thousands of installations prove its stability under a wide range of conditions.



IN THE TRENCH, man-hours are cut. Fewer men are needed for handling. Most sizes can be installed without mechanical handling equipment.

IN SUPPLY LINES, Transite's immunity to tuberculation means lower pumping costs. Its high flow capacity (C=140) is tuberculation-proof.

AS DISTRIBUTION MAINS, Transite Pipe cannot cause "red water." Its high corrosion resistance means low maintenance over the years.

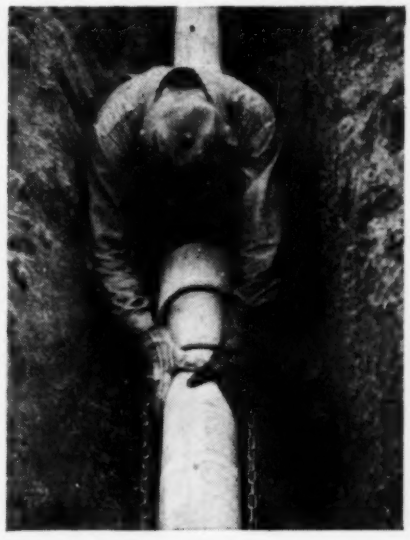
Wherever it's used . . .

AS YOU CAN SEE—Transite Pipe is unusually light in weight . . . easily handled and unloaded. Installation takes less time . . . and fewer men.

JOHNS-MANVILLE
JM
PRODUCTS

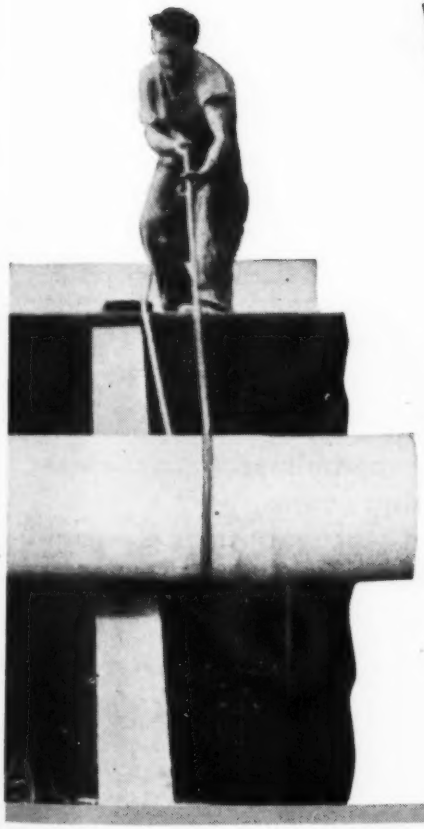
ON CURVES and in hilly terrain, Transite Pipe's flexible Simplex Coupling permits up to 5° deflection at each joint without use of fittings.

UNDER HEAVY TRAFFIC the Simplex Coupling provides a flexible joint that effectively withstands vibration—absorbs the shocks of heavy vehicles.



AT THE JOINTS, Simplex Couplings mean quick, easy assembly. They safeguard against underground leakage and undermining of supporting soil.

TRANSITE PIPE HOLDS DOWN WATER LINE COSTS



WITH an eye to *future economy* as well as *present-day efficiency*—thousands of forward-looking communities are using TRANSITE PRESSURE PIPE—in both water transmission and distribution lines.

Made of asbestos and cement, this tough durable pipe saves installation, operating and maintenance costs.

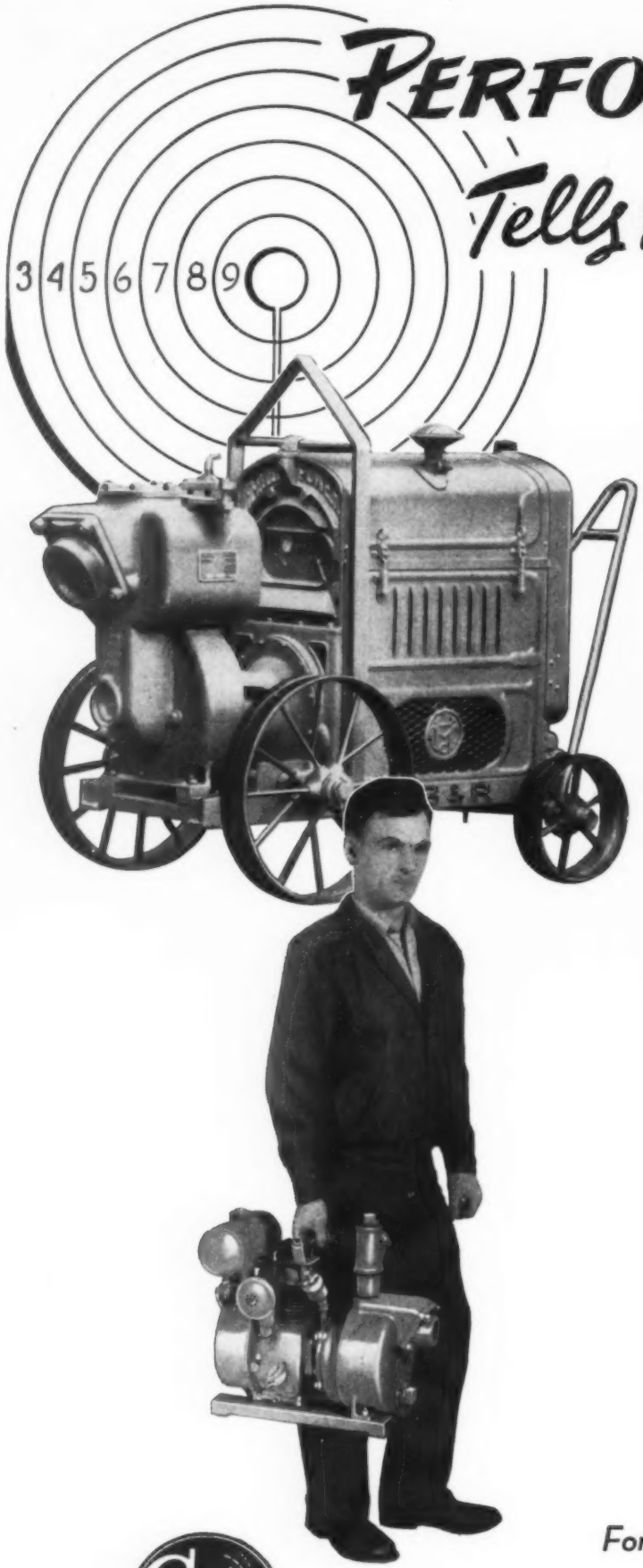
Light in weight, it is easily handled. The Simplex Coupling permits quick assembly . . . forms tight yet flexible joints. Highly corrosion-resistant, this modern pipe withstands aggressive soils. Because Transite's high carrying capacity (C=140) can never be reduced by tuberculation, pressures are higher, pumping costs lower . . . an added margin is provided for future water needs.

For details, write for Brochure TR-11A. Address Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville TRANSITE PIPE

PERFORMANCE!

Tells more than Words



For size of pump, for power consumed, for dollar invested, Gorman-Rupp pumps will out-perform any other pump. This is a "put up or shut up" proposition for we are willing to let you prove this for yourself by a free trial with no strings attached.

There is a Gorman-Rupp pump to fit any job. If you want a handy all purpose pump as easy to carry as a bag of tools, the sturdy little "Midget" will fill the bill. It will deliver as much as 3000 gallons per hour at continuous performance. If you have a heavy dewatering job that calls for as much as 125,000 gallons per hour get a Gorman-Rupp heavy duty model pump.
Gorman-Rupp self-priming centrifugal pumps never have to be shut down to be cleaned out -- there is no recirculation orifice to get plugged nor control valve to get jammed.

They are streamlined inside where streamlining counts.
Ask what you want of a Gorman-Rupp pump. Give it any kind of a test. Actual performance on the job will convince you.

For details call your nearest distributor.

THE GORMAN-RUPP COMPANY

GORMAN-RUPP PUMPS — UNSURPASSED FOR PUMPING FAST

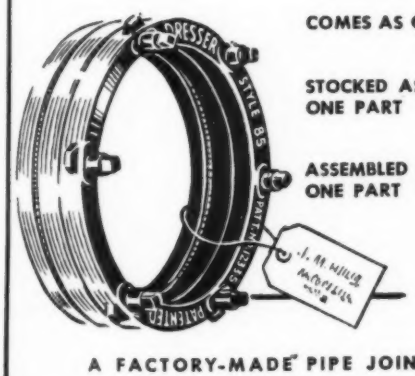
327 Bowman Street — **Mansfield, Ohio**

For TURTLE-BACK PROTECTION

Specify

THE DRESSER BELLMASTER JOINT

It's easy to handle



COMES AS ONE PART

STOCKED AS ONE PART

ASSEMBLED AS ONE PART

A FACTORY-MADE PIPE JOINT

Once you bury it, you can forget it. The Bellmaster joint is protected against corrosion by the bell itself.

It's fast and easy to install, too. Just insert the Bellmaster joint in the bell, turn, stab pipe home, and tighten bolts. Any workman can install it with a simple wrench. It takes as little as two minutes (depending on the diameter), in any weather, in wet or dry ditch. It's easy to handle . . . you receive it as one part . . . stock it as one part . . . assemble it as one part.

The Bellmaster joint stays tight permanently. The resilient gasket seal gives it flexibility to absorb stresses due to temperature variations, earth movements and traffic shock.

Write your favorite foundry for information about Bellmaster pipe . . . write Dresser for information about Bellmaster joint.

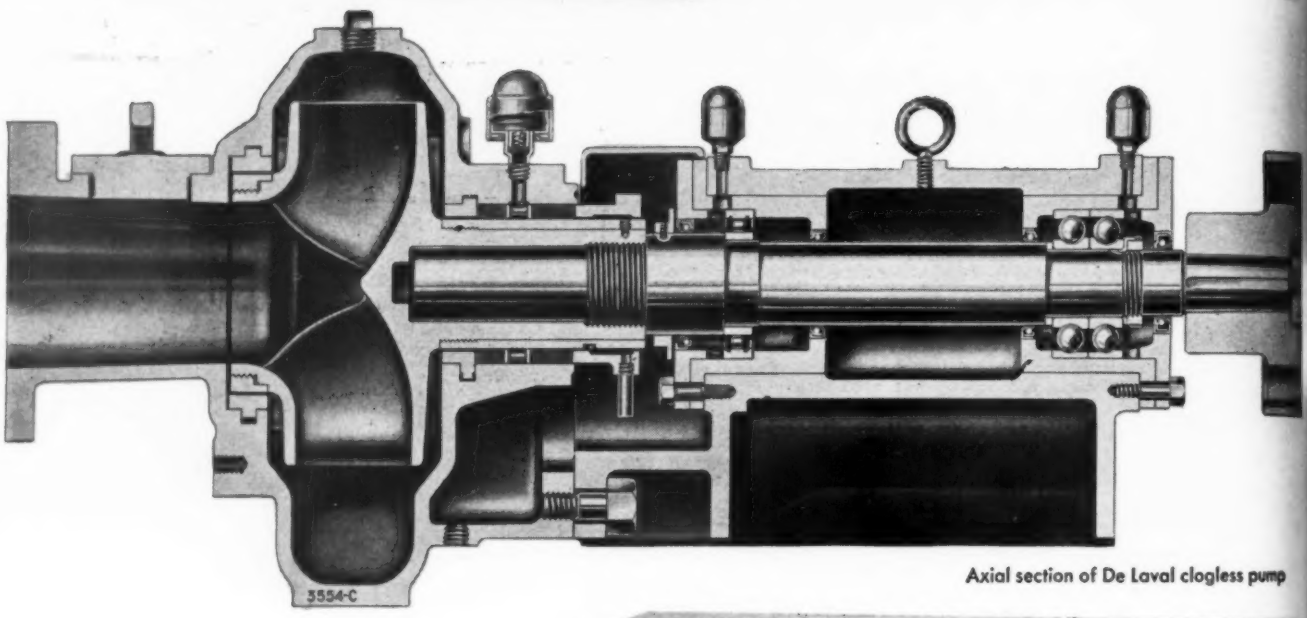
DRESSER MANUFACTURING DIVISION
427 Fisher Avenue, Bradford, Pennsylvania
In Texas: 1121 Rothwell St., Sec. 16, Houston, Texas.
In Canada: Dresser Manufacturing Co., Ltd., 60 Front Street, West, Toronto, Ontario.

DRESSER BELLMASTER JOINT

ONE OF THE DRESSER INDUSTRIES

ANY SEWAGE PUMP WILL WEAR

... but a DE LAVAL NEED NEVER WEAR OUT!



Axial section of De Laval clogless pump

ALL wearing parts in a De Laval Clogless Pump are readily renewable. The pump casing is split at the center line of the shaft to give access to the interior. The efficiency of the pump can be quickly and inexpensively restored by replacing the renewable wearing rings on the impeller and in the casing. Without this De Laval feature replacement, machining or rebuilding of the impeller and re-machining of the casing would be necessary to restore original clearances.

De Laval Clogless Pumps are built for long life, and sustained efficiency. Write for Catalog P-1250.

3309

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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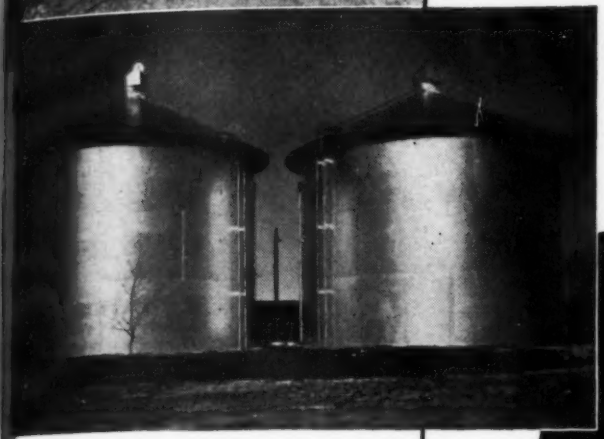
WHERE NATURAL ELEVATIONS ARE AVAILABLE . . .

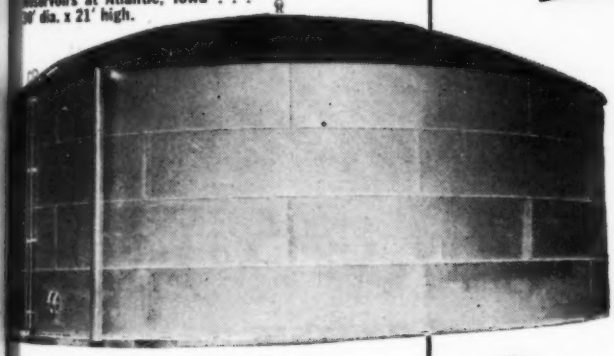
PITTSBURGH-DES MOINES

Steel

RESERVOIRS



Two 100,000-gallon capacity P-DM Reservoirs at Atlantic, Iowa . . . 30' dia. x 21' high.

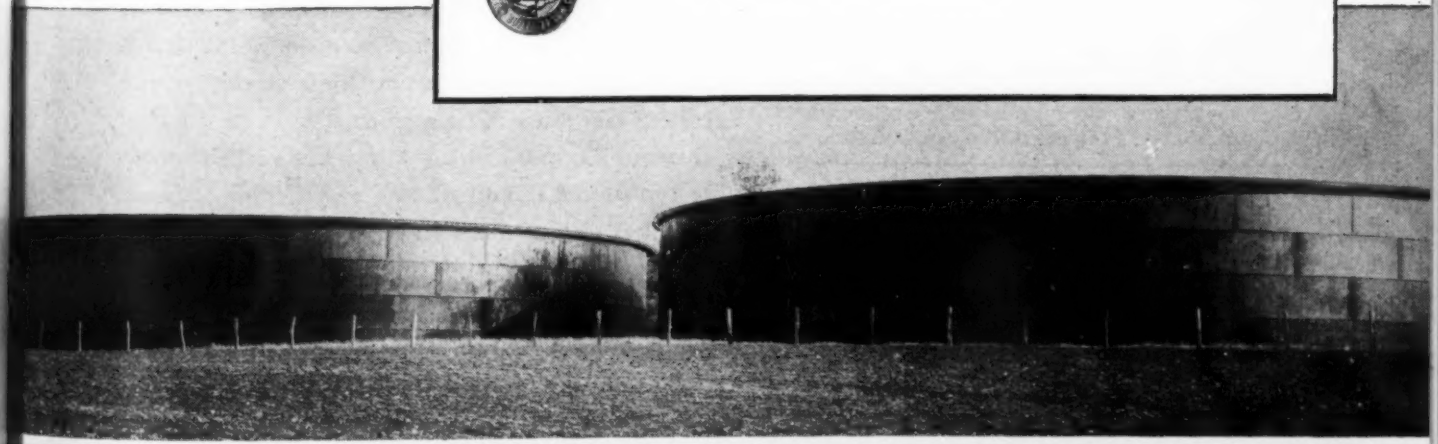


Above—1,000,000-gallon P-DM Reservoir at Bottineau, N. D., 84' dia. x 24' high.

Below—two 3,000,000-gallon P-DM Reservoirs at Berryville, Va., . . . 144' dia. x 25' high.

ASSURE MAXIMUM ECONOMY IN BETTER WATER SERVICE

The permanence of steel, its strength, lower cost and ease of erection, apply to particular advantage in the reservoir storage of water. Pittsburgh-Des Moines Steel Reservoirs are impervious to the effects of climate, seasonal changes and weather—cannot crack, spall or deteriorate. With simple maintenance and periodic painting they are good for a lifetime—a truly sound investment! *Let us consult on your needs.*



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Everdur Metal

permits Strong, Lightweight, Built-up Construction . . .

THE OPERATING ADVANTAGES of construction that combines strength with light weight are well known to sewage and water works engineers. Such construction is possible with Everdur* because these durable copper-silicon alloys combine high strength with excellent resistance to corrosion.

Everdur Copper-Silicon Alloys are readily workable and weldable, and are available in plates, sheets, rods, tubes and casting ingots. Standard compositions are manufactured for hot or cold working, machining or recasting. There is practically no limit to the types of equipment into which this durable, economical metal can be fabricated. For detailed information, write for Publications E-11 and E-6. 46218

*Reg. U. S. Pat. Off.

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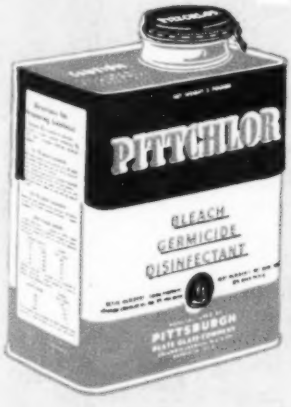
I hear they're going to use

PITTCHLOR



You can bid goodbye to chlorine-susceptible microorganisms, bacteria and algae in water supplies when you use Pittchlor—the high-test calcium hypochlorite containing a minimum of 70% available chlorine. Used for sewage treatment . . . for disinfection, deodorizing and general sanitation, Pittchlor proves highly effective.

Granular in form, Pittchlor is stable, dry, white, non-caking and free flowing. It is stocked by leading jobbers in 5 lb. resealable cans (9 per case), 3¾ lb. cans (12 per case) and in 100 lb. drums.

No special equipment or expensive installations are required for most uses. Solutions of desired strength for numerous applications can be made quickly when needed . . . write for descriptive literature.

COLUMBIA CHEMICALS

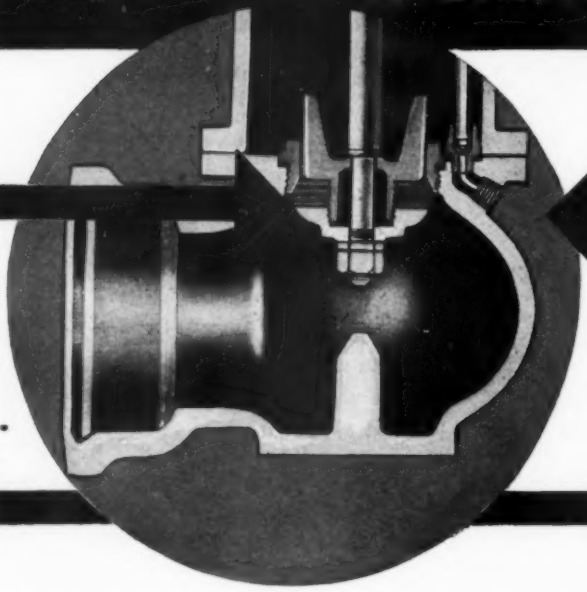
PITTSBURGH PLATE GLASS COMPANY · COLUMBIA CHEMICAL DIVISION

FIFTH AVENUE at BELLEFIELD, PITTSBURGH 13, PENNSYLVANIA · Chicago · Boston · St. Louis · Pittsburgh
New York · Cincinnati · Cleveland · Philadelphia · Minneapolis · Charlotte · San Francisco

COLUMBIA ESSENTIAL INDUSTRIAL CHEMICALS

Soda Ash · Caustic Soda · Liquid Chlorine · Sodium Bicarbonate · Pittchlor · Silene EF (Hydrated Calcium Silicate) · Calcium Chloride · Soda Briquettes (Iron Desulphurizer) · Modified Sodas · Caustic Ash · Phosflake (Bottle Washer) · Calcene T (Precipitated Calcium Carbonate)

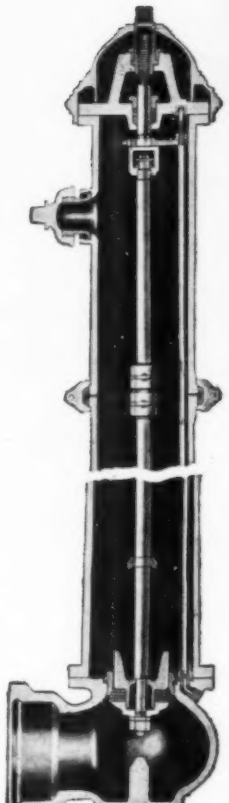
LEAKAGE THRU DRAIN *can never undermine* A SMITH HYDRANT



WHEN THE MAIN VALVE IS OPEN OR PARTIALLY OPEN . . .

THE DRAIN IS ALWAYS CLOSED

The Smith Hydrant is so designed that the drain is open *only* when the main valve is *completely* closed. Water under pressure cannot pass through the drain in the event that the main valve is improperly closed or even partially open.



Only SMITH *offers all of these* FEATURES:

1. ***Frost-proof, tapered barrel.*** Frost can't upheave a Smith Hydrant because the tapered barrel breaks the grip as the ground swells.

2. ***Low friction loss.*** Barrel cross-section exceeds valve area by 200%.

3. ***Collision protection.*** The Smith Protectop coupling confines breakage to quickly and inexpensively renewed parts.

4. ***Quick accessibility.*** All working parts easily removed and replaced without excavation.

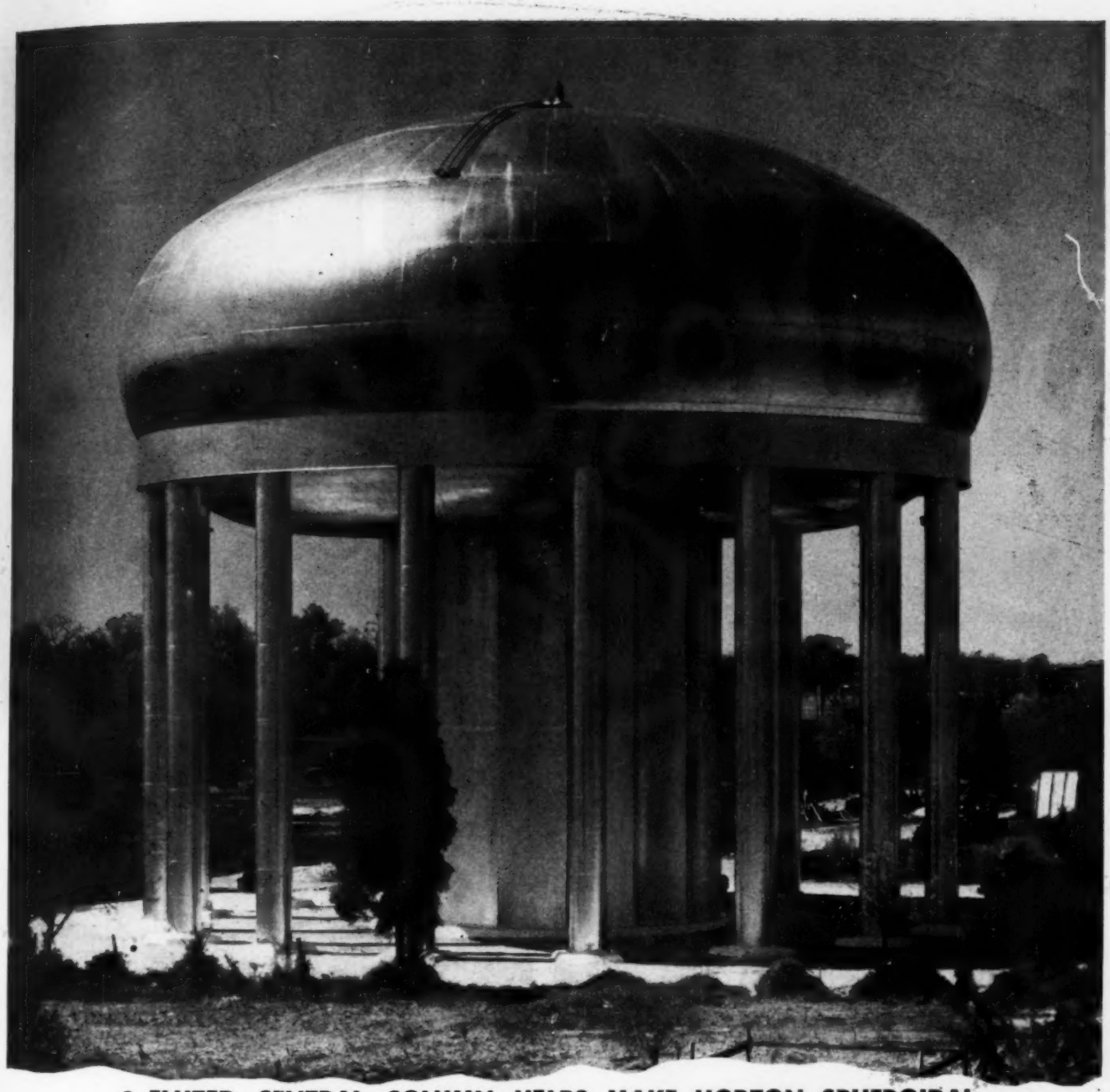
16

FIRE HYDRANTS
GATE VALVES
CHECK VALVES
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES



● FLUTED CENTRAL COLUMN HELPS MAKE HORTON SPHEROIDAL WATER TANK *"Years Ahead in Design"*

In August, 1944, we were asked to submit a design for an elevated tank at Washington, D. C., based on the following:

"Overflow to be at elevation 382. Elevation of ground at site 295-300. Permissible range in head 35 ft. Design as pleasing in appearance as possible."

The result is the 2,000,000-gal. Horton tank shown above. It was installed to provide a reserve in storage independent of direct pumping to supply increasing consumption in a rapidly expanding demand area and to relieve low-service suction of peak demand withdrawals for high service pumps.

The fluted central column is new in elevated tank design. It serves primarily to support the center of the tank bottom and does not contain water. There is a separate 5 ft. diam. riser on the inside that is connected to the mains. The tank is 49 ft. to bottom, has a diam. of 106 ft. and a range in head of only 34 ft.. 6 in. It is supported on sixteen 4-ft. diam. outer columns and the 40-ft. diam, central column. Our engineers are ready to work with you in designing Horton elevated water storage tanks to meet your particular needs. Write our nearest office outlining your requirements.

CHICAGO BRIDGE & IRON COMPANY

Chicago 4.....2198 McCormick Bldg.
New York 6.....3390-165 Broadway Bldg.
Cleveland 15.....2262 Guildhall Bldg.
Los Angeles 14.....1455 Wm. Fox Bldg.
Birmingham 1.....1586 North 50th Street
Atlanta 3.....2181 Healey Bldg.
Tulsa 3.....1646 Hunt Bldg.
Houston 1.....5615 Clinton Drive
Philadelphia 3.....1644-1700 Walnut Street Bldg.
Washington 4.....703 Atlantic Bldg.
San Francisco 5.....1283-22 Battery St. Bldg.
Detroit 26.....1551 Lafayette Bldg.

Plants in Birmingham, Chicago and Greenville, Pa.
In Canada: Horton Steel Works, Limited, Fort Erie, Ont.

Diamond Liquid Chlorine

Modern quality-control methods are employed in the manufacture of Diamond Liquid Chlorine to assure production that meets your most exacting requirements. The high quality you need for water and sewage treatment is assured when you specify DIAMOND Liquid Chlorine.

Diamond Liquid Chlorine can be shipped to you in the quantities most convenient for your use—in individual cylinders, in multi-unit cars or tank cars, as you wish. And whatever the quantity, you can always depend upon the high quality of Diamond Liquid Chlorine.

ALKALI

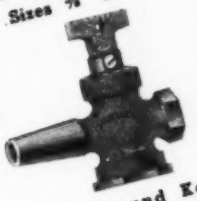
DIAMOND ALKALI COMPANY · Pittsburgh, Pa., and Everywhere

A PAGE OF BRASS GOODS VALUES

MUELLER CATALOG "H"

The MUELLER Line includes everything needed from main to curb except iron pipe. Corporation stops, goosenecks, and curb stops — for either cast iron, lead, or copper service pipe. Every stop is guaranteed to contain not less than 85% copper. Each key is individually lapped into its body to insure perfect fit, easy turning, and prevent leaks. All stops may be had with any type of connection: iron pipe, lead flange, wiped joint, copper service, or in combination. MUELLER Extension Service Boxes to protect your curb stops may be had in Minneapolis or arch pattern. The sliding upper section takes care of changes in grade levels, and prevents breakage when the box is struck a heavy blow. . . . MUELLER Brass Goods offer real savings over the years. If you are not acquainted with the full line of quality goods see any MUELLER representative or write us direct for information.

H-10203 Ground Key Curb Stop. Solid tee head round way with inside I.P. inlet and outlet. Sizes ¾" to 2".



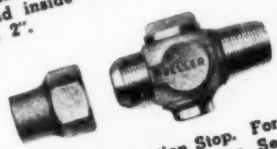
H-10213 Ground Key Curb Stop. Inverted key round way with wiped joint inlet and inside I.P. outlet. Sizes ½" to 2".

H-10215 Ground Key Curb Stop. Inverted key Minneapolis pattern round way with lead flange inlet and inside I.P. outlet. Sizes ½" to 2".

H-10302 Minneapolis Pattern Service Box. H-10306 Arch Pattern Service Box. Upper section is fully adjustable.

H-10001 Corporation Stop. For inserting with MUELLER Tapping Machines. With ⅛ bend coupling. MUELLER Thread inlet. Sizes ½" to 2".

H-10003 Corporation Stop. With proper service clamps this stop may be used on wrought iron pipe. Sizes ½" to 2".



H-15000 Corporation Stop. For use with MUELLER Copper Service Pipe and inserting with MUELLER Tapping Machines.

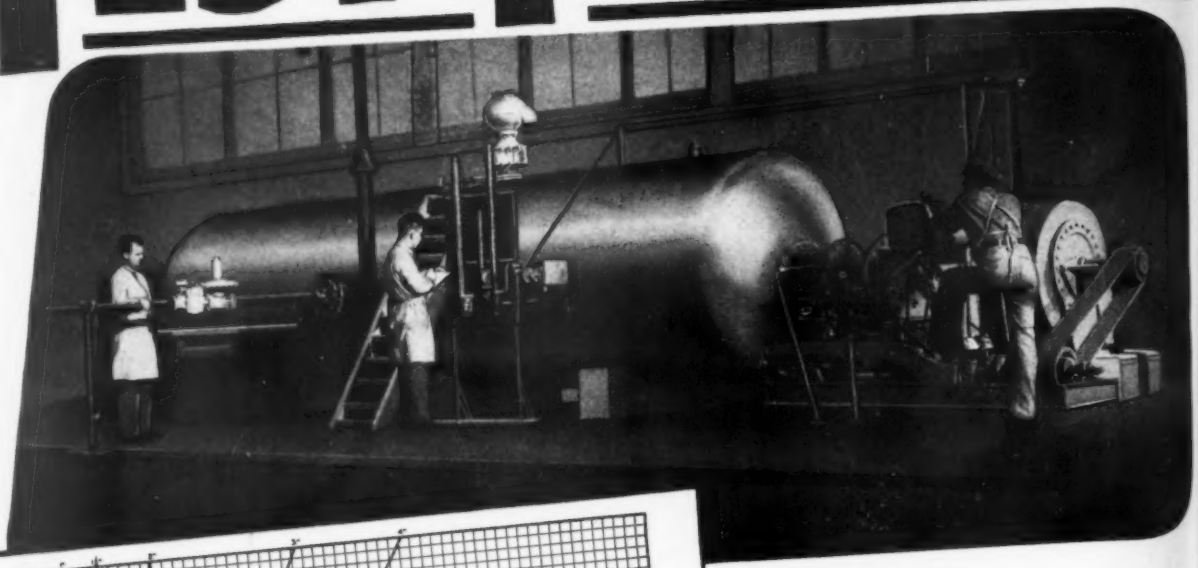
H-10002 Corporation Stop. For lead pipe. PATENTED knurled faces on coupling hold pipe with everlasting grip. Sizes ½" to 2".

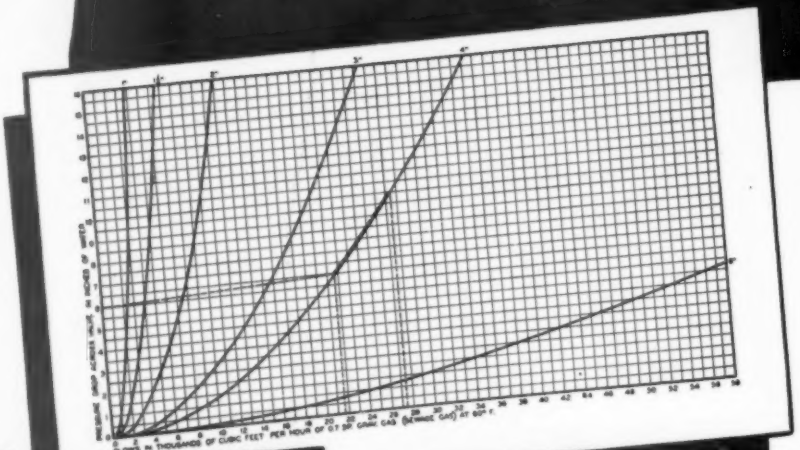
H-10150 Lead Flange Gooseneck Extra heavy lead pipe. Sizes ¾ to 2". Also available in 2, 3, 4, and 8 branch models.

MUELLER CO.

DECATUR, ILL. • LOS ANGELES, CALIF. • CHATTANOOGA, TENN. • SARNIA, O

...IF IT'S "Varec" - IT'S TEST-PROVED





S-3

"VAREC" approved BACK PRESSURE REGULATOR (DOUBLE PORT)

FIGURE NO. 186.

The above chart shows actual flow capacities. This regulator will maintain a back pressure to within 5% of the desired predetermined pressure. It is particularly advantageous for installation where dependable, delicate up-stream control is important.

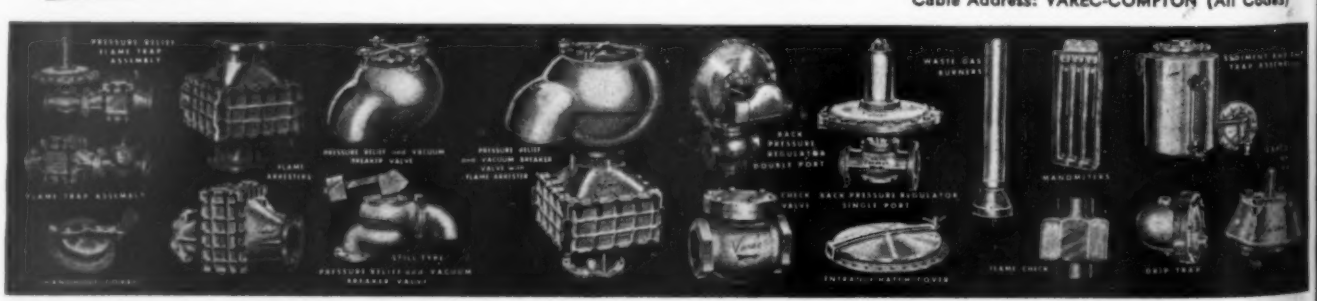
THE PACE SETTER SINCE 1928

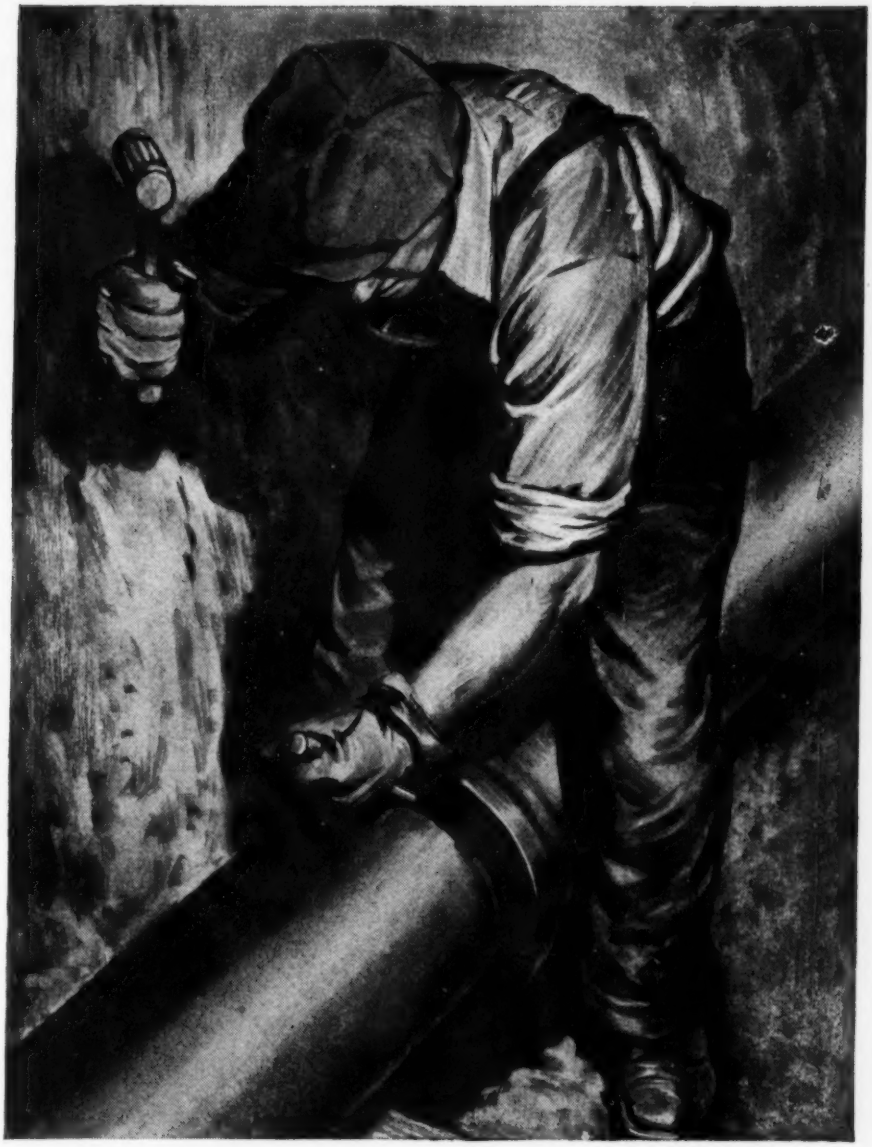
"VAREC" approved SEWAGE GAS CONTROLS

THE "VAREC" Testing Laboratory illustrated above includes what is probably the largest and most up-to-date capacity finding apparatus in existence. It accurately determines pressure loss and flow capacities up to 500,000 cubic feet per hour. Characteristics of gases when mixed with foreign elements as well as corrosive qualities are also determined by thorough analysis and test investigations. All "VAREC" Equipment is tested to exact field application; the large vessel reduces velocity head to a true static head, thus giving true capacity and pressure drop. Write for your copy of the new "VAREC" Sewage Gas Control Handbook S-3, which gives factual information determined in this laboratory, as well as diagrams, charts, and other data of great value to sanitation engineers.

THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA

NEW YORK CITY—CHICAGO, ILL.—HOUSTON, TEX.—TULSA, OKLA.
Agencies Everywhere
Cable Address: VAREC-COMPTON (All Codes)

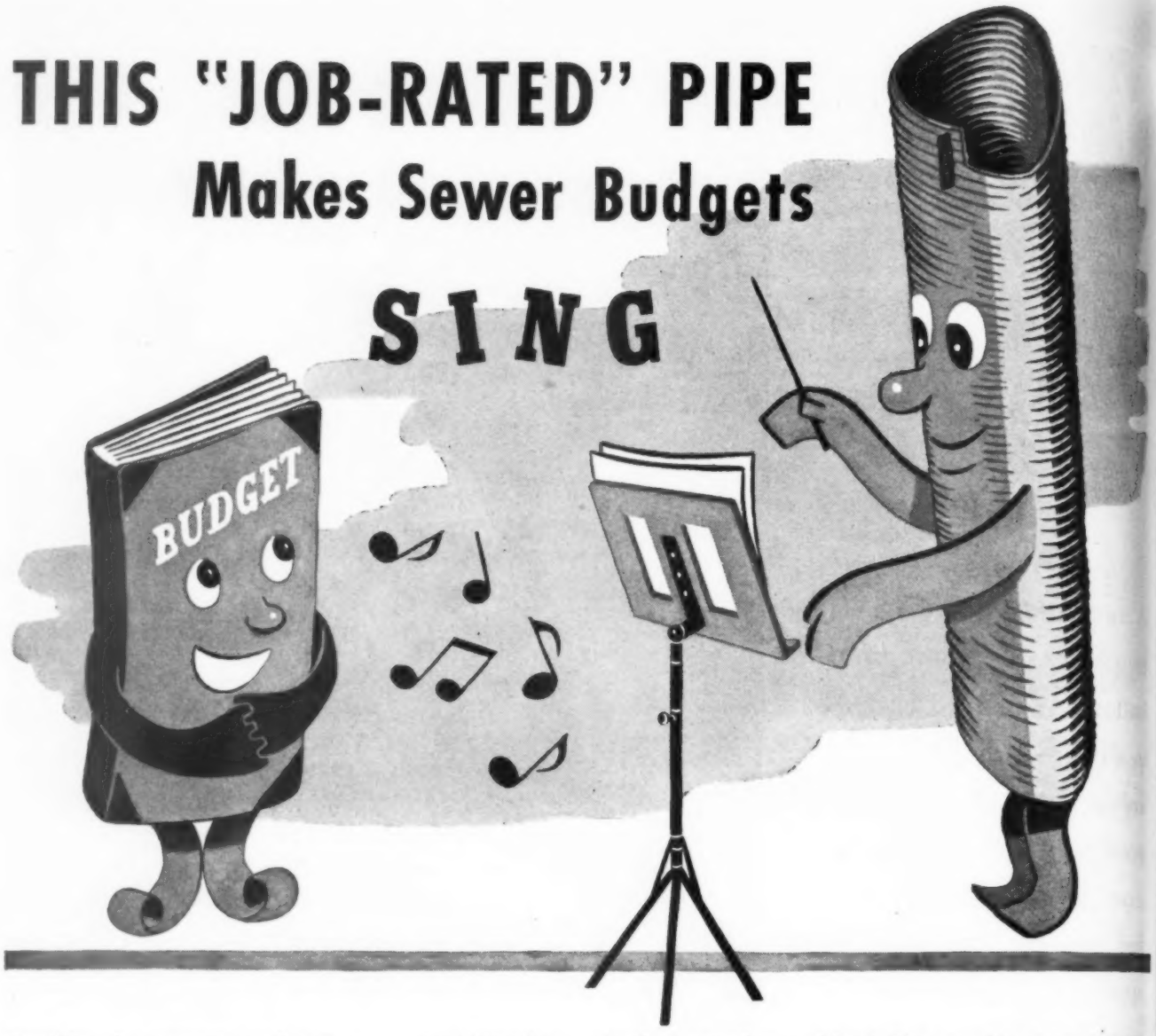




A well-calked joint—a level trench without humps or hollows—a tamped backfill in all but sandy soils: these are simple fundamentals of good practise in laying cast iron pipe. Observe them and you give the pipe full opportunity to deliver the centuries of useful life built into it at the foundry. For, cast iron pipe, like all materials of construction, must be properly installed if it is to give maximum service with minimum maintenance cost. Our new 16 mm. sound motion picture, "Installing Cast Iron Pipe" is available, on loan, without charge, to water and sewage works officials, engineering schools and organizations. Address Dept. G, Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 S. Michigan Ave., Chicago 3.

CAST IRON PIPE
SERVES ✓ FOR CENTURIES

THIS "JOB-RATED" PIPE
Makes Sewer Budgets
SING

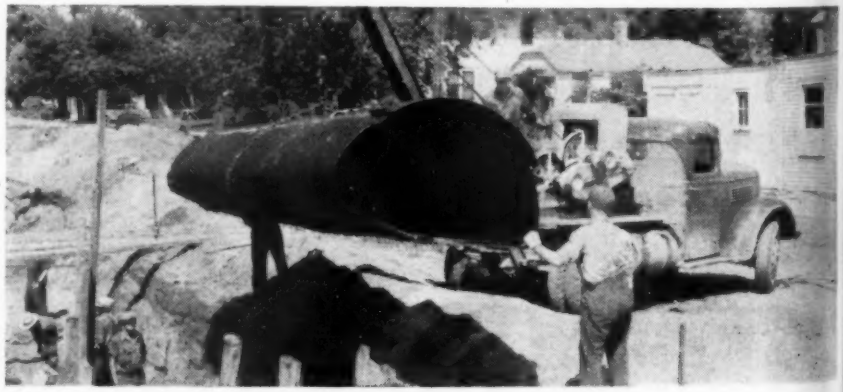


Consider the economy and convenience of using "job-rated" ARMCO Corrugated Pipe to meet varying sewer conditions. From a single source you can select the *exact* types you need and save time and money in the bargain. Here's the way it works . . .

Handling storm water is a cinch for plain galvanized pipe. Where industrial waste or other corrosive effluent is a problem ARMCO Asbestos-Bonded Pipe will take it in stride. If erosion is present a paved invert will make the bottom last as long as the top. And when you have to duck under a railroad you'll want ARMCO Pipe-Arch — especially designed for use wherever headroom is limited.

You'll find, too, that ARMCO Corrugated Metal Pipe has ample strength to withstand heavy loads, frost action or the impact and vibration of traffic. It is easy to handle and unskilled workmen quickly join long lengths into a sturdy, tight conduit with corrugated band couplers.

Try "job-rated" ARMCO Corrugated Metal Pipe on that next sewer job and see for yourself how much it saves in time, money and freedom from maintenance. Write for specific data. Armco Drainage & Metal Products, Inc., and Associated Companies, 2425 Curtis Street, Middletown, Ohio.

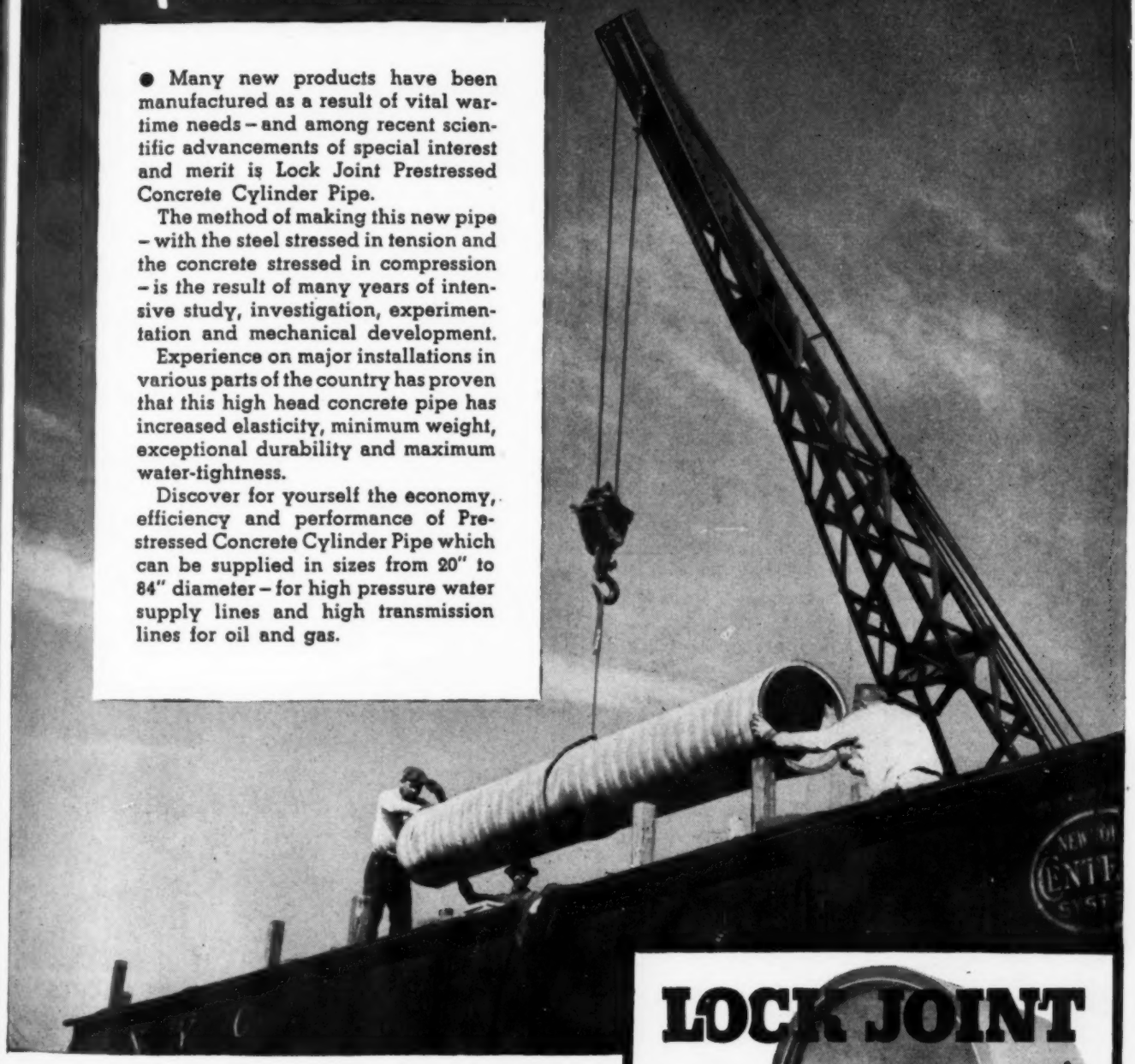


ARMCO

ARMCO CORRUGATED METAL PIPE

WATER WORKS ENGINEERS

Specify prestressed concrete cylinder pipe on your next job



● Many new products have been manufactured as a result of vital wartime needs – and among recent scientific advancements of special interest and merit is Lock Joint Prestressed Concrete Cylinder Pipe.

The method of making this new pipe – with the steel stressed in tension and the concrete stressed in compression – is the result of many years of intensive study, investigation, experimentation and mechanical development.

Experience on major installations in various parts of the country has proven that this high head concrete pipe has increased elasticity, minimum weight, exceptional durability and maximum water-tightness.

Discover for yourself the economy, efficiency and performance of Prestressed Concrete Cylinder Pipe which can be supplied in sizes from 20" to 84" diameter – for high pressure water supply lines and high transmission lines for oil and gas.

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

LOCK JOINT PIPE COMPANY
Established 1905
P. O. BOX 269, EAST ORANGE, N. J.

Denver, Colo. · Chicago, Ill. · Kenilworth, N. J. · Kansas City, Mo. · Rock Island, Ill.
Joplin, Mo. · Valley Park, Mo. · Cleveland, Ohio · Hartford, Conn. · Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

unnecessary cuts in the street

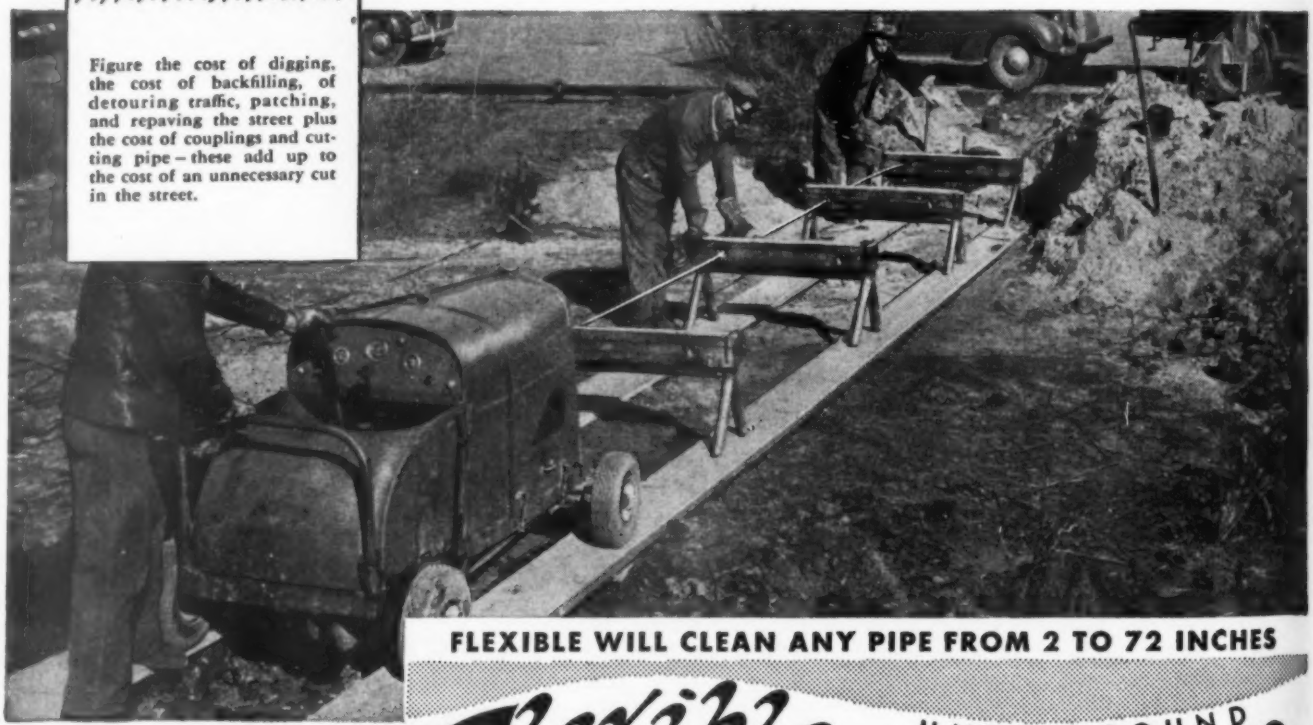
FLEXIBLE WILL STATE THE NUMBER OF CUTS REQUIRED IN THE STREET

CUTS IN THE STREET ARE COSTLY to the city—they mean ditch digging, backfilling, patching the street, detouring traffic, deterioration of the streets—and they all should be added to the cost of the pipe cleaning job. That's why Flexible has developed new modern pipe cleaning methods that reduce the number of cuts required. And to back up their confidence in lower pipe cleaning costs due to fewer cuts in the street *Flexible will state the number of cuts required in the street* to do a complete cleaning job. Furthermore, Flexible will pay for all additional cuts at their own expense except where erroneous pipe sizes are encountered or where unforeseen obstructions are encountered.

Write or wire your nearest representative. Fleets of fully-equipped Flexible service trucks with complete crews are strategically located to give service.

HOW MUCH DOES A PATCH COST?

Figure the cost of digging, the cost of backfilling, of detouring traffic, patching, and repaving the street plus the cost of couplings and cutting pipe—these add up to the cost of an unnecessary cut in the street.



FLEXIBLE WILL CLEAN ANY PIPE FROM 2 TO 72 INCHES

Flexible UNDERGROUND PIPE CLEANING CO.

9059 VENICE BOULEVARD • LOS ANGELES • CALIF.

855 Board of Trade Bldg., Chicago 4, Ill.
228 W. Broad St., Columbus 8, Ohio.
1624 Harmon Place, Minneapolis 3, Minn.
P. O. Box 165, Atlanta.
P. O. Box 694, Gulfport, Miss.
41 Greenway St., Hamden, Conn.
147 Hillside Ter., Irvington, N. J.
P. O. Box 694, Pittsburgh.
401 Broadway, New York 13.
29 Cordan Ave., Roslindale 31, Mass.

5 TYPES of STANDARD JOINTS AVAILABLE ON MONO-CAST CENTRIFUGAL PIPE

(Corrosion Resistant)

Mono-Cast Centrifugal Pipe is supplied with any of the following standard joints:

Doublex Simplex Joint (for general use)
Roll-on-Rubber Ring Joint (for general use)
Bell and Spigot Joint (for general use)
Screw-Gland Joint (for general use)
Molox Ball-and-Socket Joint (for underwater service)

All are suitable for use in systems conveying liquids. The Doublex Simplex Joint is bottle tight in conveying gas and liquids at high pressure.

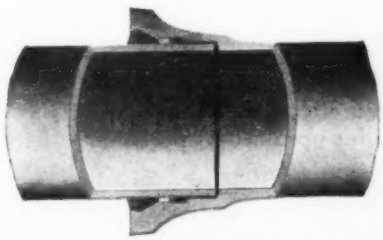
Mono-Cast centrifugal pipe with its long service life is cheapest in the long run. Can be furnished with standard or Enameline cement linings. Alloy irons furnished for special service.

Write for catalog.

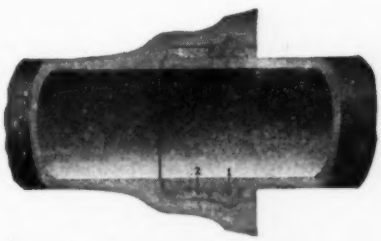
AMERICAN CAST IRON PIPE COMPANY

Birmingham 2, Alabama

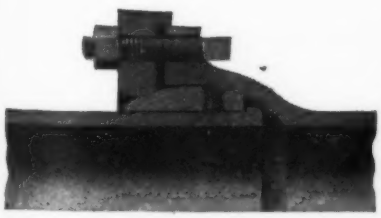
Chicago Minneapolis Kansas City Los Angeles New York
Cleveland Dallas Houston San Francisco



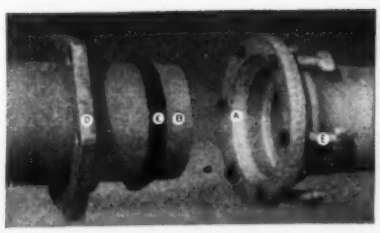
Roll-on-Rubber Ring Joint



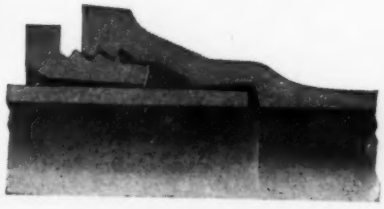
Bell and Spigot Joint



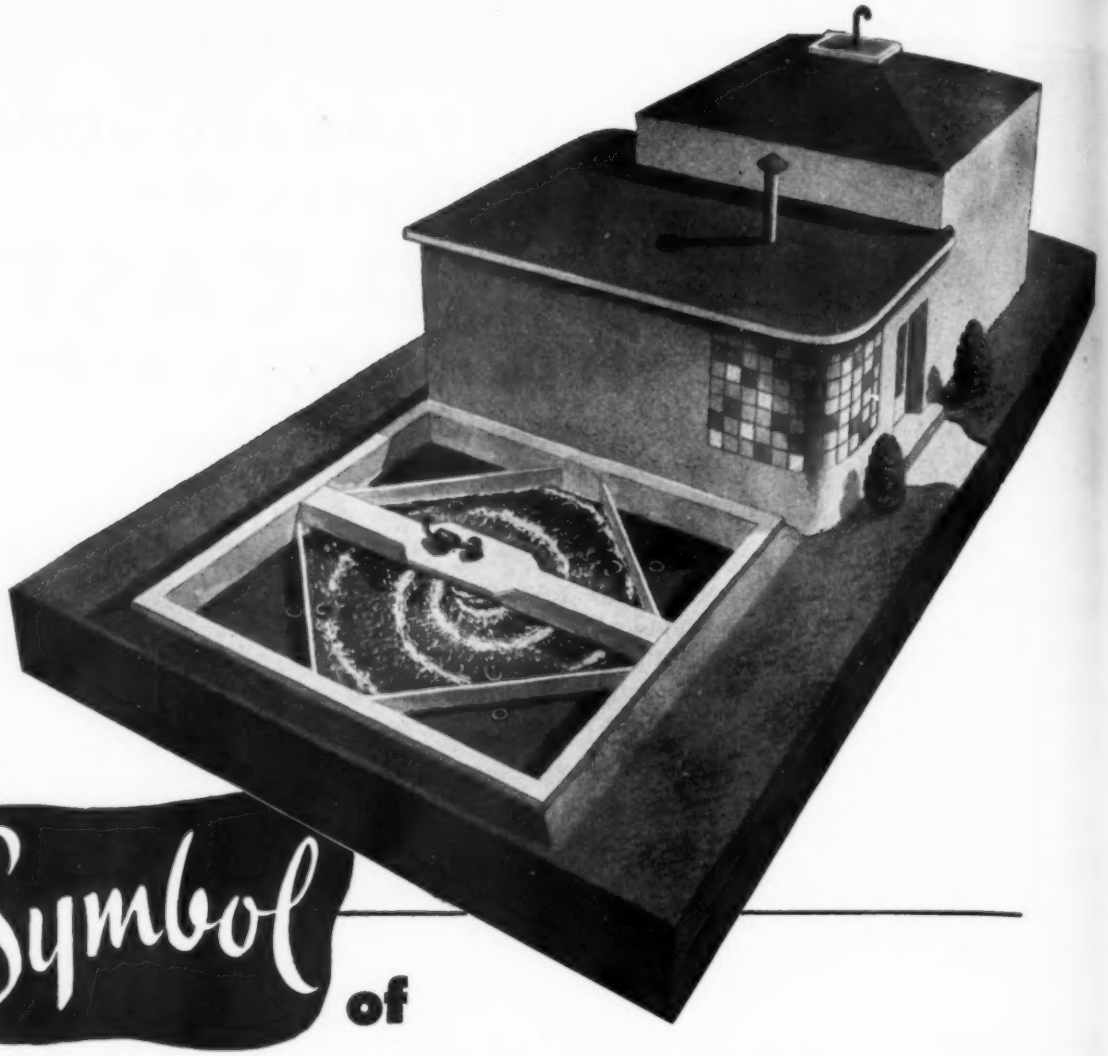
Molox Ball-and-Socket Joint



Doublex Simplex Joint



Screw-Gland Joint



Symbol of a Community with the RIGHT IDEA

Aeration and final sedimentation in a single concrete structure of minimum dimensions . . . simple, smartly modern, proved efficient: that is the Yeomans "Aerifier" Package sewage treatment plant.

Tailored and "packaged" to fit specific needs, Yeomans "Aerifier" produces crystal clear effluent at exceptionally low over-all plant cost. It is ideal for small communities up to 3000 persons, and for isolated institutions and industrial plants.

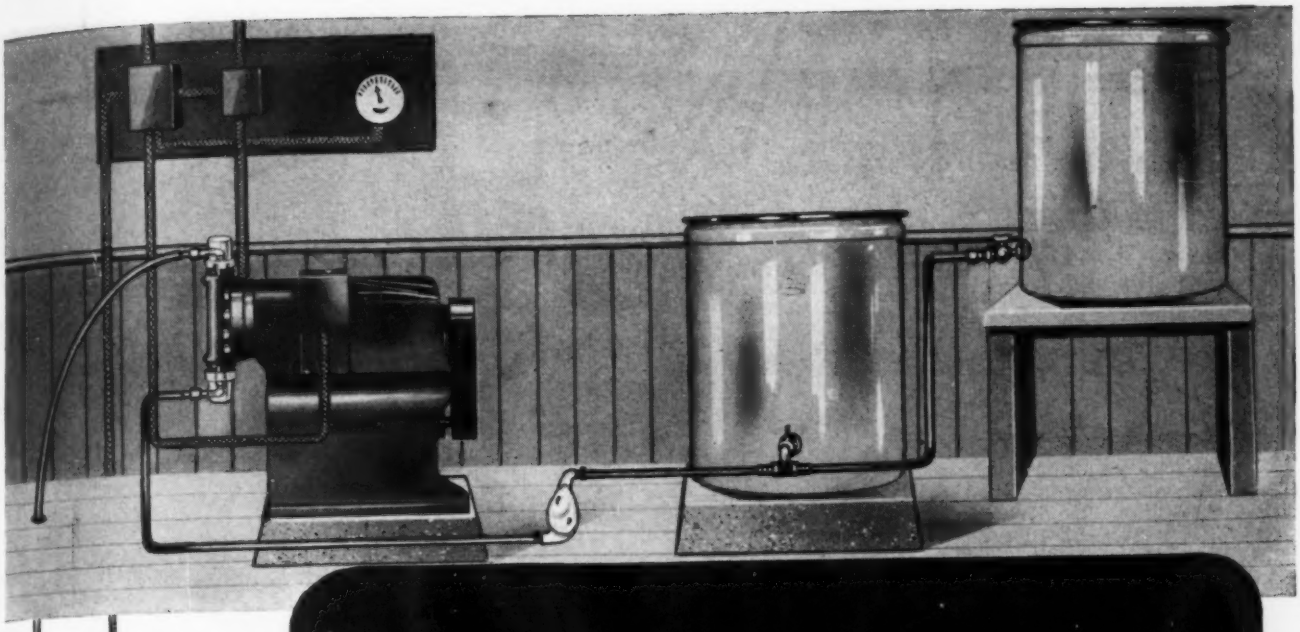
Operation is simplified to a daily routine check. All units are open for visual inspection . . . clean, free from odors.

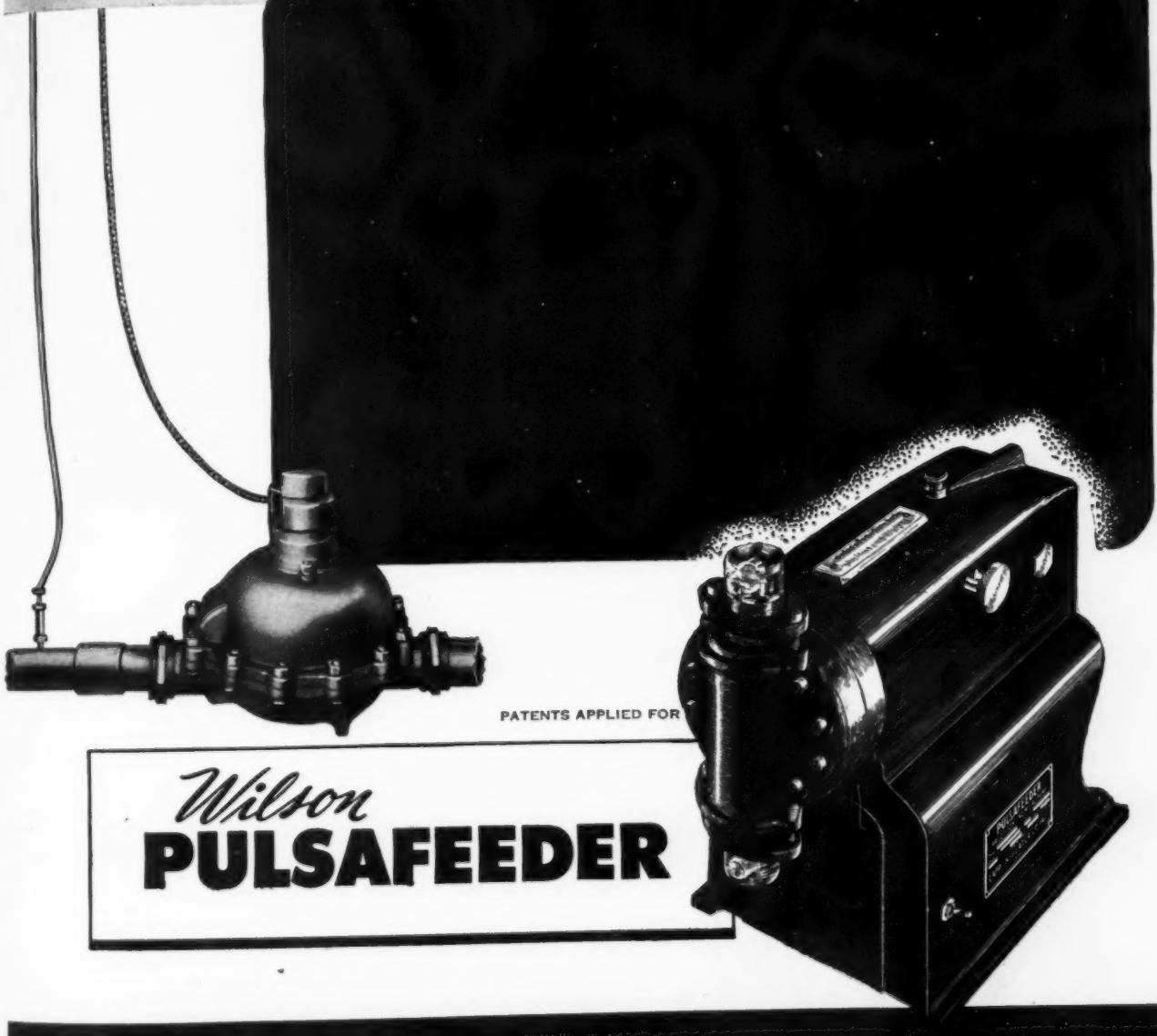
Yeomans "Aerifier" installations include final adjustment, initial factory operation, and thorough training of operators. And Yeomans engineering counsel is always available.

A complete recommendation with construction cost estimates and application engineering will be furnished promptly on request.

Yeomans Brothers Company

1423 NORTH DAYTON STREET • CHICAGO 22, ILLINOIS





PATENTS APPLIED FOR

Wilson
PULSAFEEDER

Lapp

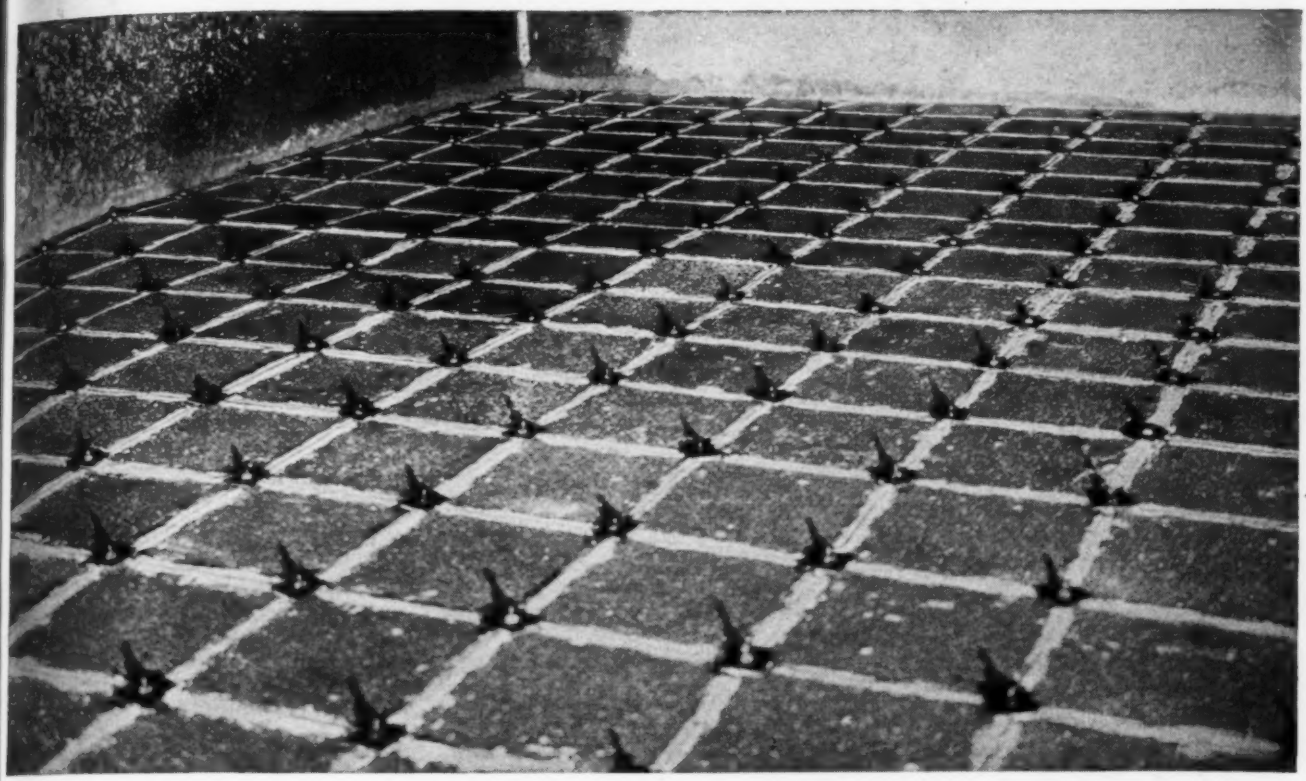
Original Woodcut by Lynd Wa

Plans for housing developments, so imperative at this time, frequently call for extensions to water and sewer mains. If constructed with U. S. Cast Iron Pipe, their annual maintenance cost will be low and the ultimate cost, lowest in the end. Long-lived and dependable cast iron water and sewer mains provide a sound and thrifty investment for a growing community.

U.S.
cast iron
PIPE

U. S. PIPE & FOUNDRY CO
General Offices: Burlington, N. J.
Plants and Sales Offices throughout the U. S. A.

How the City of NEW BRUNSWICK is Solving Water Filtration Problems



MR. HARRY DWYER, Commissioner of Water Purification

MR. ASHER ATKINSON, Former Water Consultant

The water filtration plant of New Brunswick, N. J., operates 8 gravity filters. Each has a bed 14½′ x 24′ with a rating of 1 MGD.

Four units are equipped with ALOXITE aluminum oxide porous plates—installations, as shown, being made (1) four, (1) three, and (2) two years ago. Mushroom type strainers are used in the remaining four filters. (Expectations are that at least two of them will be converted soon.) In the meantime, an excellent opportunity for service comparison is presented. Here is what it shows.

Sand clogging the mushroom strainers is a consistent headache. Frequently backwashing pressures approaching the danger point are needed to clear them. Moreover, backwashing is non-uniform —mud balls are formed—the graded gravel is upset.

None of these difficulties is experienced in the filters employing ALOXITE plates. With graded gravel eliminated displacement is no problem. Backwashing is uniform over the entire bed. Added to this is an extra factor of safety in that high pressures are not required during the backwashing operation.

Actual figures clearly illustrate further economies. Washed in 5 minutes, only 5,000 gallons of wash water are needed per unit equipped with ALOXITE plates. The other units average 12 minutes and use twice as much wash water.

With conditions so much better, it is only logical to expect a lower bacterial count. And that is exactly what chemical analysis shows. The improvement in water characteristics is more than satisfactory.

A typical example, this brief resumé of the experience of the City of New Brunswick confirms the findings of other users of ALOXITE plates. Reason enough why you will find it makes sense to discuss the advantages of porous media by CARBORUNDUM with one of our technical staff. Write Dept. O-56, The Carborundum Company, Refractories Division, Perth Amboy, N. J.

Underdrain Plates

BY CARBORUNDUM

TRADE MARK

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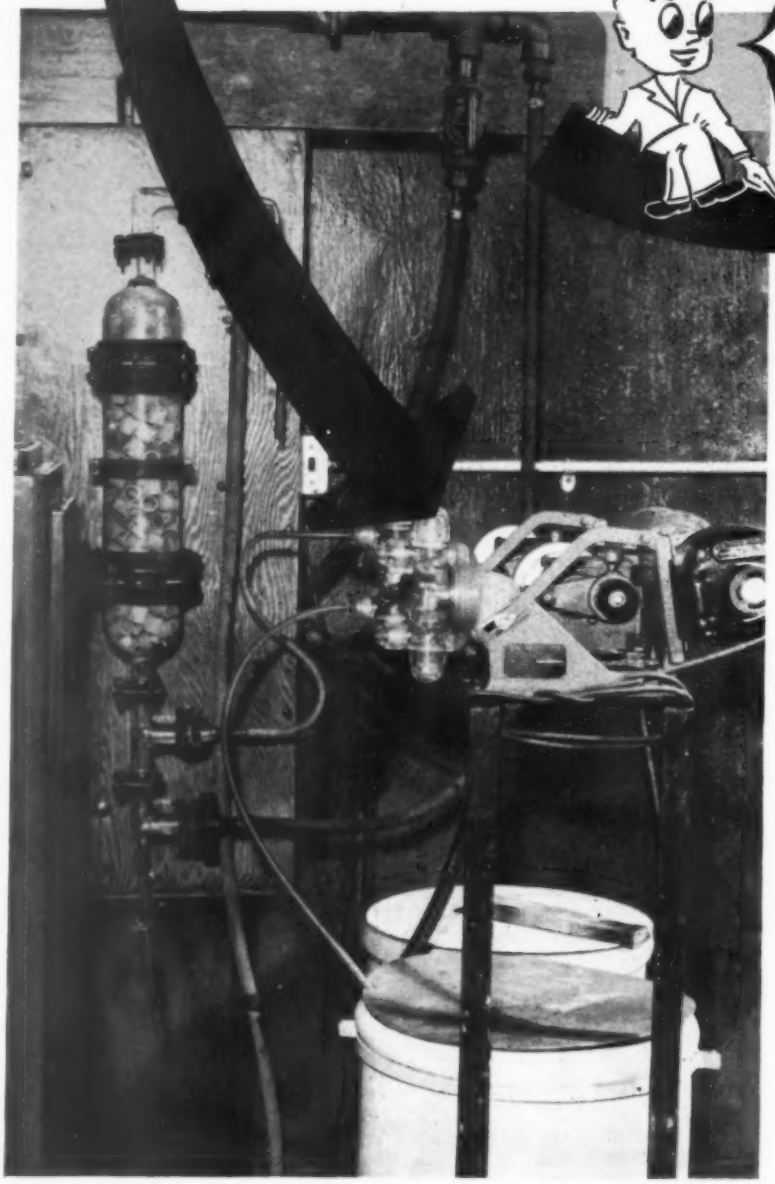

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THIS new Manual TELLS what is needed to set up a program of meter repair and testing ...SHOWS how to lay out an efficient meter shop ...PICTURES step-by-step repair instructions, presenting many hints that will save, and lead to greater meter accuracy over a longer period of years. It suggests practical ways to help you collect all possible revenue, prevent water waste, and distribute costs. The outline of its contents will show its value to large and small water utilities. Write for your copy today.

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An Outline of its
CONTENTS

PLANNED METER REPAIR. Case histories from several cities with figures on decrease of unaccounted-for water, and increase in revenue. Suggested testing schedule for small meters.

PLANNING THE METER SHOP. Essential equipment needed. Typical work flow sheet and meter shop layouts. Typical shop photos. Novel "baker's tray" parts-storage arrangement.

TESTING MEANS DOLLARS SAVED. Actual test results on repaired meters. Importance of testing at minimum flow. Tests by GPM vs. orifice size. The "milk bottle" test.

METER RECORDS SHOULD BE ACCURATE. Reproduction of ideal record-card. Data that should be included.

REPAIR AND TESTING. Eight pages containing 20 step-by-step-detail how-to-do-it photos showing high-spots in meter repair. Tools needed in a small shop. "Upside-down" storage. Further "suggestions" that will interest the repair man.

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For more revenue — less water waste — better cost distribution

Send for it — TODAY

WATER & SEWAGE WORKS

VOL. 93, No. 5 MAY, 1946

A Gillette Publication

THE INSTALLATION AND MAINTENANCE OF SERVICES AND METERS

As Practiced by the City of Winnipeg

By W. D. HURST
City Engineer
WINNIPEG, CANADA

BEFORE the Canadian Section of the American Water Works Association a paper was presented by the author on the subject of "Design of Water Distribution Systems."* A section of this paper dealt briefly with service and meter practice as carried out by the City of Winnipeg. The author has been asked by *Water and Sewage Works* to develop further the outline given in the paper and this article is the result.

The Author

Services Materials

About 47,000 services are in use in Winnipeg. The first services were installed in 1882 and consisted of wrought iron pipe followed by lead tubing in 1894. As the local soil conditions were subsequently found to be very destructive of wrought iron and steel pipe, the use of this material was abandoned and lead tubing and cast iron pipe (in the larger sizes, 3-in. and above) was continued until 1924, when A. S.T.M. Type "K" copper tubing was substituted for lead tubing in the smaller sizes (up to 2-in.). The reason for the latter substitution was that it was found that as the lead pipe aged in the local corrosive soils, it tended to become brittle and granular, and the heaving by frost and/or expansion and contraction of the clay soil caused failure.

The use of copper tubing was continued until 1942 when this material became unavailable owing to war conditions. No failures of the copper tubing occurred between 1924 and 1941, and it cannot be stated what the ultimate life of this tubing is except that it exceeds twenty years in this area.

Lead pipe, too, had given good service but its useful life appears to be between thirty and forty years on the average in this area.

Corporation stops (or cocks, as they are sometimes known) of the ordinary lead flange coupling type were used until 1924. When the use of copper pipe began the copper flange coupling type was used exclusively. Corporation stops up to a 2-in. size are inserted in the main under pressure, using a Mueller corporation tapping machine. They are inserted horizontally.

Curb stops (or cocks) are set in the sidewalk about 15 inches from the property line. They formerly were of the lead flange coupling type, but since 1924 the copper flange coupling type has been used.

Fig. 1 shows the style of curb stop used until 1936 when it was superceded by the inverted key (or plug) stop and drain type. The latter was adopted in order to insure the draining of inactive services to prevent freezing and to facilitate easy operation. The curb stops used prior to 1936 were fastened by brass screws to an oak or creosote treated plank about one foot square by two inches thick, with the service box of the "Buffalo" type (somewhat modified), resting on the wooden plank and arching over the curb stop. Very often when the operator went to shut off the service he found it impossible to enter the curb stop key into the tee head of the curb stop as heaving of the soil, or settlement of the same had caused misalignment of the curb stop and service box, diverting the tee head of the curb stop over to one side of the cast-iron box. Hence when the change over to the inverted key type was made both the curb stop and cast-iron service box were redesigned, insuring that the service box fits snugly around the body of the curb stop as shown in Fig. 2, preventing the curb stop from becoming misaligned through heaving or settlement. In place of screwing the curb stop to a creosoted plank the service box was provided with lugs with holes drilled in the same, and it was secured to the plank with brass screws. All misalignment troubles were overcome in this manner. We felt that the redesigned service box and curb stop

*Published in *AWWA Journal*, April, 1945.

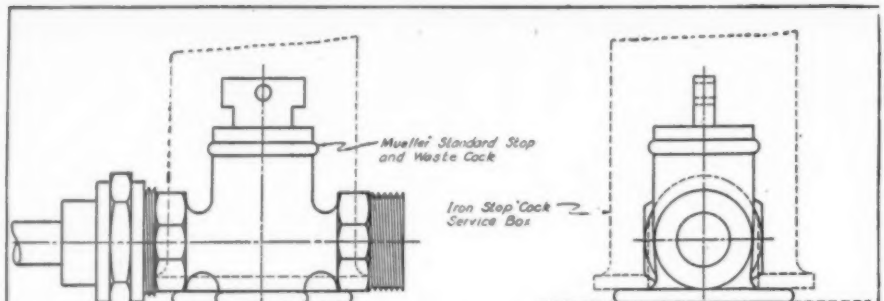

Mueller Standard Stop and Waste Cock
Iron Stop Cock Service Box
Recess in wooden block to suit stop & waste cock
Wooden Block
Wooden Base Plate

Fig. 1—Old Style Type "A" Standard Stop and Waste Cock.

had some advantage over the "Minneapolis" type, as it allowed for any slight movement due to heaving or settlement but not to such an extent as to cause misalignments.

Corporation Cocks and Curb Stops Home-Made

Our engineering department fabricates all its own corporation and curb stops in its own machine shops, purchasing the rough castings from a local brass foundry. The savings have amounted to many thousands of dollars, to say nothing of facilitating the supply of the same during the critical war years. Specifications for the rough castings require the metal to consist of 85 per cent copper, 5 per cent lead, 5 per cent tin, 5 per cent zinc.

Services 3 in. in diameter and above are laid using Class 150 cast-iron pipe. In these cases the corporation and curb stops are omitted and replaced by a "Smith" sleeve and valve inserted into the street main under pressure with a drilling machine. Services up to 8 in. in diameter are constructed in this manner.

City Engineer Decides Size of Service on Customer's Property

The Winnipeg charter provides that "the City shall pay the cost of putting in and keeping in repair the service pipes from the waterworks mains to the street line. The work of laying and keeping in repair the service pipe between the street line and any building shall be done by the owner of such building." The waterworks ordinance provides that "The City Engineer shall determine the size of services in the street and in the property which will be normally adequate to serve any premises, and the owner or applicant shall not install services smaller than the size so determined."

The latter rule came into practical effect in 1936 but prior to this the Department had adopted a "laissez faire" attitude of matching in the street the same size of service that the owner (or more properly the owner's contractor) had chosen to install in the property. This almost invariably resulted in the service being too small to render adequate service and had apparently been adopted in order to free the Department of responsibility for undersized services and resulting poor pressure. The Department in 1936 determined that it should assume its proper responsibility and set the minimum size of service to be installed at ¾ in. In the ordinance, which is reproduced further on as Exhibit "A," a scheme for the determination of the proper size of service is given for the information of contractors and the general public.

The scheme, as will be noted, is an empirical one and serves very well for most cases. In the more complicated cases the Department makes an analysis for determination of pipe size similar to that given in the University of Wisconsin Engineering Experiment Station Bulletin No. 77, "Interior Water Supply Piping."

Services Installed with Pipe Pusher

As the soil in the Winnipeg area is largely clay it has been found desirable to install and renew water services using a pipe-pushing machine as follows: An excavation (3 ft. 6 in. x 6 ft.) is made over the watermain and transverse to the same, while another excavation (2 ft. 6 in. x 4 ft.) is made at the street line where the curb stop is to be installed, both excavations being carried to a 9 ft. depth. When these excavations have been completed the operator bores a short distance from one excavation toward the other with a hand-operated augur. The pipe-pushing machine is then set up in the most convenient excavation. (The Department owns two types of pipe-pushing machines, the first a "Simplex" mechanical type; the second a "Greenlee" hydraulic type, both of which operate satisfactorily.) The operator now feeds convenient lengths (usually 4 ft.) of steel pipe into the pipe pusher, directing them toward the opposite excavation and screwing them together as they are pushed out of the machine. The first length of iron pipe is equipped with a "snub nose" coupling with a plug in it. The square head of this plug has a hole drilled through it. The operator keeps coupling additional lengths of steel pipe and pushes the same until the first pipe reaches the opposite excavation. A small hole is then drilled through one end of a coil of lead pipe or copper tubing and a wire is passed through this hole and the hole in the "snub

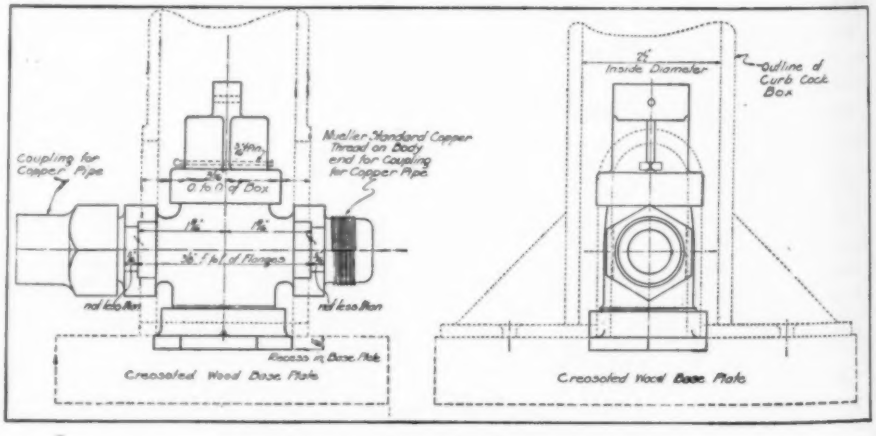

Coupling for Copper Pipe
Mueller Standard Copper Thread on Body end for Coupling for Copper Pipe
Inside Diameter
Outline of Curb Cock Box
Creosoted Wood Base Plate
Creosoted Wood Base Plate

Fig. 2—New Type "B" Inverted Key Standard Stop and Waste Cock.

nose" pipe, and twisted together. The pipe pusher is now operated in reverse, pulling the iron pipe back into the original excavation where it is successively uncoupled and of course brings along with it the copper or lead pipe. The pipe-pushing machines have been operated successfully up to a distance of 60 feet, but in cases where considerable underground ducts or pipes of other utilities are encountered the distance to be pushed is shortened by making additional excavations.

The width of streets in residential areas in Winnipeg is 66 feet, of this 24 feet is given to paved roadway, 10 feet to concrete sidewalks (two five-foot sidewalks), and the balance (32 feet) is dedicated to two 16-foot planting spaces. The watermain is located 14 feet from the property line on the east and north sides of streets and avenues, which places it 9 feet from the edge of the sidewalk in the planting space. Hence a 14-foot service is required for buildings on the same side of the street as the watermain while a 52-foot service is required to serve buildings on the opposite side of the street.

In the renewal of water services the old lead pipe is salvaged where practical and sold as scrap lead.

CITY OF WINNIPEG—ENGINEERING DEPARTMENT
WATERWORKS OPERATING BRANCH

WATER SERVICE RECORD

Service No..... Date.....194...
Street and No.....
Nature of Building.....
Nature of Service.....
Size.....
S.C. Distance from St. Line.....
Position of S.C.....
.....
Position of C.C.....
.....
Length Main to St. Line.....
Corp. Cock..... Stop Cock.....
Length of Excavation.....
Average Depth of Excavation.....
Frost Penetration.....
Connected to.....Copper Lead Pipe on Property in Sewer Trench.....
Cut.....
Nature of Repairs.....
Material.....
.....
.....
.....
Remarks:.....
.....
Form No. 38.—3M-4-45 SIGNATURE

Fig. 3—Water Service Record Form.

The use of service trenchers for installing services in new developments is not looked on with favor by the Department, owing to the fact that it is very difficult to secure adequate backfilling of such trenches in this area, with the result that pavement failures occur over these trenches and a utility problem is transferred to the street maintenance department.

Complete Record of Service Installations

A complete record of all service installations is kept in the office.

When an application for a new water service is received a clerk transfers all the relevant information from the application form to an alphabetically street indexed record book. The following information is entered therein: (1) street and number; (2) date of application; (3) contractor's name. A space is also provided for the date of completion and for the number of the service. The clerk then makes out a report slip with the contractor's name, and the street and number to be serviced and the size of the service to be provided. This report slip is retained by the service foreman until the job has been completed, when he enters on the same the date of completion and returns it to the office.

The service is now ready to be connected and the service connector

Meter Repair Room—Winnipeg.

Plan No. ..... Service No. 51549

WINNIPEG WATERWORKS SERVICES

Lot ..... Block ..... Street No. .....

Owner .....

Nature of Service ..... Size ..... When Laid .....

Stopcock Distance from Street Line .....

Position of Stopcock .....

.....

Position of Corporation Cock .....

.....

Length Main Pipe to Street Line .....

Corporation Cock ..... House Stopcock .....

Kind of Pipe Laid .....

Earth Excavation ..... feet. Average depth ..... feet.

Connected to ..... Pipe on Property in Sewer Trench.

REMARKS:

Fig. 4—Permanent Water Service Record Form in Bound Book.

makes out a service record card for each service (see Fig. 3). He enters on the card the following information: street and number, size and length of service, material used, depth of excavation, distance of curb stop or valve from the street line, distance of curb stop or valve from the nearest cross street (line), and a convenient short measurement taken from some prominent feature.

These service cards are turned in to the office each morning, the service is given a number which is cross entered into the alphabetical street index book and all the information on the service card is entered into a bound permanent (numbered) service book (see Fig. 4). A card indexed under street and number is also made out and filed to record all "turn-ons" and "turn-offs" required.

Therefore, when a question arises concerning a service all that is necessary to know is the street and number. The street index is consulted, which gives the service number. The permanent service book is then consulted where all the relevant information — except "turn-ons" and "turn-offs"—may be found.

EXHIBIT "A"

Simplified Method for Determination of Service Sizes

Water service line size will ordinarily be determined by the City Engineer through application of the following rules. The same may be used by the trades and others for estimating purposes. The minimum size of service connections shall be as given in Table C, which is based on the application of Tables A and B.

TABLE "A"

Estimated Maximum Quantity for Each Fixture

Fixture	U. S. Gallons Per Min.
One ¾" hose connection for lawn or garage	12
One ½" hose connection for lawn or garage	6
One ½" bath tub connection	9
One ¾" bath tub connection	12
One ⅜" wash basin connection	4

Form No. 19-4m-12-44

CITY ENGINEERING DEPT.—W.W. OPTG. BRANCH

TURN ON ORDERS

DATE ..... No. .....

CAUSE OF ACTION	LOCATION	DATE OF ACTION	TIME OF ACTION	REMARKS

Turnkey's Signature

Fig. 5—Water Service "Turn-on" Record Card.

(A salmon-colored card of some 5x8½ inch size, with heading "Turn-off," is used for recording "Turn-offs.")

One ½" wash basin connection	6
One ½" laundry tub connection	12
One ½" kitchen sink connection	9
One ⅜" water closet tank connection	4
One ½" water closet tank connection	6
One 1" water closet flush valve connection	30
One ½" shower bath connection	6
One ½" urinal tank connection	6
One ¾" or smaller urinal tank connection	2½
One 1" urinal flush valve connection	30

The usual expected demand as given in Table B following is based on preceding Table A.

TABLE "B"

Expected Demand Quantity
(Based on Demand Rates in Table A)

For one family houses, 33⅓% of maximum demand in gallons per minute for all cold water fixtures.

For two family houses, 25% of maximum demand in gallons per minute for all cold water fixtures.

For three and four family houses, 20% of maximum demand in gallons per minute for all cold water fixtures.

For larger apartment houses, factories, laundries, shops, and for unusually long services, a special estimate of demands and service connection sizes will be made by the City Engineer's Office.

TABLE "C"

Allowable Minimum Sizes of Service Connections

Minimum allowable size of service connections for usual expected demand obtained from Tables A and B:

U. S. Gals./Min.	Service Inch
1 to 35	¾
30 to 60	1
48 to 105	1½
90 to 200	2

Where there is an overlapping of sizes the larger size for a given quantity of water shall be used where the static pressure is 34 lbs. or under, and the smaller size shall prevail where the static pressure is 35 lbs. or more.

Meters

Winnipeg is practically 100 per cent metered. The only exceptions to 100 per cent metering are houses where freezing conditions in the basement render metering impossible.

Metering was begun in 1900 and it was decided at that time to standardize on a definite make and type of meter. Accordingly an oscillating piston type meter was chosen at that time for use on all domestic and light demand commercial services, while the velocity type meter and the compound type was chosen for heavier demand commercial and industrial services. The domestic meters (⅝ in. to 3 in.) were required to be supplied with a straight-reading dial, open intermediate gearings and breakable frost bottoms. The specifications of

the American Water Works Association for cold water meters covered general requirements. This situation lasted until 1934 when the company manufacturing this type of meter ceased operations in Canada. The Department then re-specified a definite make of nutating disc type meter for ⅝ in. to 3 in. size and a definite make of compound meter for sizes 3 in. and larger, and proportional type meter for fire services. This policy has been very advantageous for the department for it has simplified the stockroom problem of repair parts and has given the meter mechanics a real opportunity to concentrate their skills on a single make of meter.

In 1934 the Department began manufacturing its own meter repair parts in its machine shops. This policy has proven advantageous to the Department for the following reasons:

1. The annual savings have run into several thousand dollars.
2. It has eliminated delays in receiving parts (particularly important under wartime conditions).
3. It has provided employment for local foundries and has taken up slack periods in the city's machine shops.

Office Procedure and Handling Meters in the Field

The city is divided into five districts for the purpose of water meter installation and renewal, and for the turning on and shutting off of water services at the curb stop. A District Operator is assigned to each of the five districts. An order book for each district is kept in the office and all orders pertaining to meters installed, or to be installed or removed, and all turn-on and turn-off orders are entered in these books.

If the order received is for the turning on or turning off of a water service the original order is transcribed from the order book onto a white card (see Fig. 5) if the order is "Turn-on", and onto a salmon colored card of the same design except for the words "Turn-off" if it is for a "turn-off."

A number of orders for the same district may be entered on each card which is later turned over to the District Operator for action as described below.

If the order is for meter work it is transcribed from the record book on to a meter card (see Fig. 6) the color of which is different for each year up to a seven-year period when the sequence of colors is repeated. Only one order to a card is possible in the case of meter cards as this card is perforated across the center; the lower half of the card is for the use of the field meter man while the upper half is for the use of the meter repair shop and test room. The upper half has a hole punched through it and is provided with a cord by which the card can be tied to the meter.

The lower half of the card provides space for the following information:

1. Street address.
2. Date, time, and cause of action.
3. Size, make and number, and reading of meter removed.
4. Size, make and number, and reading of meter installed.
5. Material used, meter and turnkey time taken, accounts to be charged and operator's signature.

The upper half of the card provides space for the following information:

1. Size, type and make, number and reading of meter, and years of service.

METER SERVICE CARD

MAKE—SIZE—TYPE ..... METER NO. .....

YEARS OF SERVICE ..... READING .....

TEST	TEST FLOW	Maximum	Intermediate	Minimum
	Before Repairing			
	After Repairing			
	Meter registers at		U.S.G.P.M.	
	Rate of flow in U.S.G.P.M. is		at 25 p.s.i. Loss of Head	

CHANGE GEARS { Driver ..... Driven .....

TESTED BY ..... DATE .....

DATE ..... CARD NO. 1121

Cause of Action	LOCATION	Date of Action	Time of Action

	Meter Number	Meter Reading	Size	Make
INSTALL				
TAKEN OUT				
RESET				
REPAIR				

REMARKS .....

MATERIAL .....

METER TIME ..... ACCT. NO. .....

TURNKEY TIME ..... ACCT. NO. .....

OPERATOR'S SIGNATURE .....

No. 65—10M—12-45

Fig. 6—Meter Service Card—5x7½" Yellow Color

Each year a new color is used for these cards. The card is perforated across center, the lower half being for use of the field meter man and the upper half is tied to the meter for use in the shop. On the back of upper half are listed the reasons for repairs.

CITY OF WINNIPEG
ENGINEERING DEPT. WATER WORKS BRANCH Nº 3020

TO THE FINANCE DEPARTMENT:
I beg to Report on the following Meters: DATE.....19.....

TAKEN OUT					RESET		
ADDRESS	METER No.	STYLE OF METER	INDEX	REMARKS	METER No.	STYLE OF METER	INDEX

Fig. 7—Portion of Page from Record Book Showing Meters Removed and Reset.

CITY OF WINNIPEG
ENGINEERING DEPARTMENT — WATER WORKS BRANCH Nº 747

To the FINANCE DEPARTMENT:
The following Meters were REPAIRED this date.
Date.....194.....

NO. OF METER	ADDRESS	STYLE OF METER	INDEX	REMARKS	WORKMAN

Fig. 8—Portion of Page from Record Book Covering Meters Repaired.

CITY ENGINEERING DEPARTMENT
WATER WORKS BRANCH Nº 9873

To the FINANCE DEPARTMENT:
I beg to report the following meters INSTALLED this date.
Date.....19.....

NO. OF METER	NAME	ADDRESS	STYLE OF METER	INDEX	REMARKS	WORKMAN

Fig. 9—Portion of Page from Record Book Covering Meters Installed.

2. Test results.
3. Change gears.
4. By whom tested and date.

Reverse Face of Card

Reasons for repairs (check defect applicable).

1. Sediment.
2. Frost.
3. Hot water.
4. Worn parts.
5. Burnt.
6. Leaking.
7. Loose parts.
8. A list of meter parts used (check parts used).
9. Space for remarks.
10. Signature and date.

Routine Followed by District Operators

Every morning the District Operator makes a list of his orders from the district book, picks up his card binder and proceeds to his district. At 10 a.m. the operator contacts the office by telephone for any further orders that may have come in to the office in the interval. At noon the operators return to the office and leave the card binders before going to lunch. During the noon hour the record clerk in the office removes all the complete "On-Off" cards from the binder and enters all the facts against the order in the order book. He also makes new cards for orders received after 10 a.m.

After lunch the operators return to their districts, contacting the office again at 3 p.m., and return to the office shortly before 5 p.m. to turn in their binders.

The night clerk enters the information from the "On-Off" cards and the meter cards against the orders in the order book and enters all new orders in the order book and on the cards.

The completed "On-Off" cards are left for a day clerk to enter on permanent record cards which are filed alphabetically by street and number. The meter cards are left on the meter shop foreman's desk.

Each morning the shop foreman checks the meter cards, makes out a time sheet for the District Operators, transfers the meter number and reading from the lower to the upper half of the card, tears the card in half at the perforation, retaining the upper half of the card and returning the lower half to a clerk in the office.

He then takes the upper halves of the meter cards to the shelf in the shop provided for incoming meters and after checking the meter number and reading with the information entered on the card, attaches the cards to the meters which are then sent to the test room.

The lower halves of the cards which have been sent to the office are examined and all the information contained on them is transcribed to the permanent meter record books which are in numerical order.

A report form (see Fig. 7) for the use of the reading and billing department is then filled out. This form shows street and number where meter has been removed or installed, or exchanged, meter number and style, and reading of meter removed, and meter number, style, and reading of meter installed.

When minor repairs are made in the field or meters installed in newly constructed buildings the details are reported to the Finance Department on forms as shown in Figs. 8 and 9.

The meter shop foreman turns in to the office the upper half of the meter cards as the meters are repaired and tested. The information on the cards is transcribed into the permanent meter record books (see Fig. 10) and the cards returned to the meter test room where they are filed under size and meter number.

The system of having a different color of meter card every year is of great assistance in determining

CITY OF WINNIPEG ENGINEERING DEPARTMENT
WATER WORKS BRANCH

RECORD OF SERVICE AND MAINTENANCE OF METER No. ..... MAKE AND SIZE ..... CITY No. .....

DATE OF INSTALLATION	WHERE INSTALLED	DATE OF REMOVAL	WHY REMOVED	REGISTER READING WHEN INSTALLED	REGISTER READING WHEN REMOVED	REGISTER READING WHEN REPAIRED

Fig. 10—Portion of Page from Individual Meter Service and Maintenance Loose Leaf Record Book.
(Size of form is 15½x8 inches and printed the same on both sides.)

which meters are required to be retested in any given year.

The procedure as outlined above has been in effect, with only minor improvements and extensions, since the Department began operation.

Proposed Revision of Records

Consideration is now being given to revamping the system of records over the next two years along the following proposed lines:

As has been mentioned, the main records consist of:

1. Four large index books giving service and meter size and numbers, listed alphabetically by streets and house numbers.

2. One hundred and sixty-eight (168) bound books giving details of all services by service numbers.

3. A vertical card system giving "Turn-Off" and "Turn-On" records alphabetically by streets and house numbers.

4. Forty-six (46) ledger books giving details on all meters by meter numbers.

These four records will be combined into two systems, probably of the Kardex type.

(a) Records 1, 2 and 3 will be combined into one system which will give all information on each service, including turn-off and turn-on records. This record will be listed alphabetically by streets and by house numbers. It is possible that we may decide to sub-divide this record into the five meter turn-key districts.

A distinctively colored card will be used for each size of service.

Size and number of meter and date of installation and removal will also be noted on the service card.

Colored flags will be used to indicate the size of the meter, and the location of the flags, which can be moved, will indicate the year the meter was last tested.

The object of this system of flags is to facilitate the routine testing of meters.

(b) Record 4 will be changed from the ledger to a card system and will be listed by meter numbers as at present and essentially the same information will be noted on the cards.

A distinctively colored card will be used for each size of meter.

A bound book will also be used to list the services numerically, giving their location. This record will be used only on occasion when information on services is required and only the service number is given.

Meter Shop and Test Room Routing

After the cards have been attached to the meter by the shop foreman the meters are taken to the

TENTATIVE STANDARD METER TESTS for NEW DISPLACEMENT TYPE METERS

SIZE	U.S. GALS. PER MIN.	REGISTRATION ACCURACY REQUIRED PER CENT	CAPACITY IN U.S.G.P.M. AT 25# PER SQ. IN. LOSS OF HEAD
5/8"	1-20 0.25 0.10	98-102 90 R	NOT LESS THAN 20
¾"	2-34 0.5 0.2	98-102 90 R	NOT LESS THAN 34
1"	3-53 0.75 0.4	98-102 90 R	NOT LESS THAN 53
1½"	5-100 1.5 0.50	98-102 90 R	NOT LESS THAN 100
2"	8-160 2 0.6	98-102 90 R	NOT LESS THAN 160
3"	16-315 4 0.8	98-102 90 R	NOT LESS THAN 315
4"	28-500 7 1	98-102 90 R	NOT LESS THAN 500

TENTATIVE STANDARD METER TESTS for USED DISPLACEMENT TYPE METERS

SIZE	U.S. GALS. PER MIN.	REGISTRATION ACCURACY REQUIRED PER CENT.	CAPACITY IN U.S.G.P.M. AT 25# PER SQ. IN. LOSS OF HEAD
5/8"	10 1 0.25	98-102 98-100 R	NOT LESS THAN 15
¾"	20 1 0.25	98-102 98-100 R	NOT LESS THAN 25
1"	30 3 0.75	98-102 98-100 90	NOT LESS THAN 50
1½"	80 3 0.75	98-102 98-100 85	NOT LESS THAN 75
2"	85 3 0.75	98-102 98-100 75	NOT LESS THAN 125

TENTATIVE STANDARD METER TESTS for NEW COMPOUND TYPE METERS

SIZE OF MAIN METER	NORMAL TEST FLOW LIMITS (U.S.G.P.M.) ACCURACY REQUIRED 97%-103%	MIN. TEST FLOW, U.S.G.P.M. ACCURACY REQUIRED 90%	DIFFERENCE IN RATE OF FLOW AT BEGINNING AND END OF "CHANGE OVER" SHALL NOT EXCEED	FLOW IN U.S.G.P.M. AT WHICH LOSS OF HEAD SHALL NOT EXCEED 25# PER SQ. IN.
1½"	2-100	0.5	20	100
2"	2-160	0.5	32	160
3"	4-315	1.0	63	315
4"	6-500	1.5	100	500
6"	10-1,000	3	200	1,000
8"	16-1,600	4	320	1,600

"CHANGE OVER" MEANS WHEN ACCURACY OF REGISTRATIONS FALL BELOW 97%

TENTATIVE STANDARD METER TESTS for NEW CURRENT TYPE METERS

SIZE OF METER	NORMAL TEST FLOW LIMITS (U.S.G.P.M.) ACCURACY REQUIRED 97%-103%	MIN. TEST FLOW U.S.G.P.M. ACCURACY REQUIRED 90%	FLOW IN U.S.G.P.M. AT WHICH LOSS OF HEAD SHALL NOT EXCEED 25# PER SQ. IN.
1½"	12-100	5	100
2"	16-175	7	175
3"	24-400	10	400
4"	40-700	15	700
6"	80-1600	30	1600

Fig. 11—Winnipeg's Standard Flow Rates for Meter Testing.

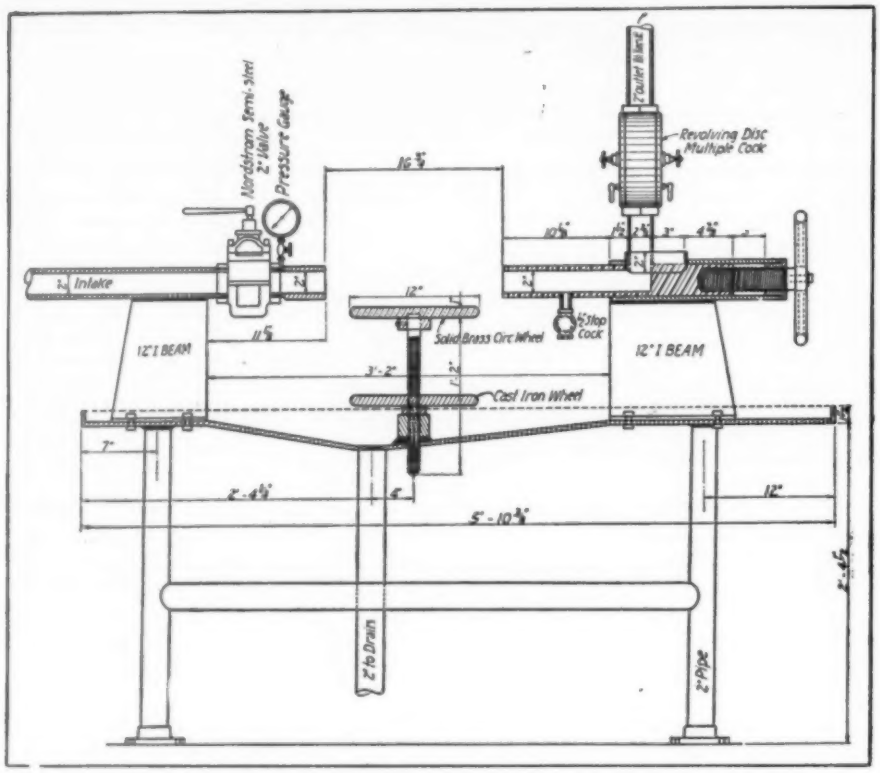


Fig. 12—Meter Test Machine for ⅝ in. to 2 in. Meters.

Meter Test Room for a preliminary test before being sent to the Meter Shop. The preliminary test consists of running the meter at the meter manufacturer's recommended **maximum** flow rate, and the error in registration is noted on the meter card. This procedure has been of value, as complaints of excess charges are often received from a customer after the meter has been removed from his premises for routine testing and not on account of a previous complaint. We call these tests "tests before adjustment."

After the meter has been repaired in the shop the mechanic ticks off the material used, all repair parts being printed on the meter card.

He then signs the card, reattaches it to the meter and sends it to the Test Room for the "standard test."

The "standard test" consists of running all meters on a maximum and a minimum flow. The ⅝-in. and ¾-in. meters are tested on a maximum flow of 10 and 20 US. GPM., respectively, for a 1 cu. ft. run by weight, and at a minimum flow rate for both sizes of 1.0 US. GPM. The percentages of error allowed for both minimum and maximum flow rates is 98 per cent to 102 per cent, but in addition the meter must register at 0.25 US. GPM. The 1 cu. ft. test has proven satisfactory for ⅝-in. and ¾-in. meters and comparison with a 10 cu. ft. test has shown differences of only half of one per cent in accuracy.

The "standard test" for larger meters of 1 in., 1½ in. and 2 in. is a 10 cu. ft. test at rates of flow of 30, 80 and 85 US. GPM. for maximum flow rate, and a minimum flow rate of 3 US. GPM. is used for these sizes. A 98-102 per cent registration is required and in addition a 90, 85 and 75 per cent registration respectively at least is required for a 1 cu. ft. test at a rate of 0.75 US. GPM. for all three sizes.

Fig. 11 gives in tabular form the standard test data.

In testing compound meters (3 in. and larger) a maximum flow rate is run for 100 cu. ft.; an intermediate flow rate for 10 cu. ft. run, and a minimun flow rate (3 US. GPM.) for 10 cu. ft.

If the meter passes the standard test the results of the test are marked on the card together with the change gear data.

If the meter fails to pass the test it is booked as a rejected meter and sent back to the mechanic who signed the card, for further repairs or adjustment. All completed meter cards are turned in to the office at the end of the day and the information given thereon is transferred to the permanent meter record books and the cards returned to the test-room for filing.

Meters used during the summer months only are labelled as "Summer Service Meters" and are given a trial test each Fall as they are taken out.

Meter Testing Room

The method of testing meters in Winnipeg during the past 11 years has been by weight of water passed through a meter into a tank on a balanced scale. One meter at a time is tested.

The Department is equipped with three testing machines. Two are capable of testing meters from ⅝ in. to 2 in. in size and the third machine is capable of handling meters from 3 in. to 8 in. in size. One small machine is equipped with a quick change multiple orifice device while the other is equipped with a "Rotameter." All three machines, with the exception of valves, scales, orifices and Rotameters, were designed by the Department and constructed in its machine shops.

Figs. 12 and 13 give the details of these machines. The two small machines have separate tanks of 100 Imp. Gal. capacity set on separate 1,000 lb. capacity scales. These scales are constructed with a percentage of error bar which enables the operator to read directly the error in meter registration. The large testing machine is equipped with an 1800 Imp. Gal. tank on a 15,000 lb. capacity dial scale. When using this machine it is necessary for the operator to compute the error in meter registration.

With the present equipment the test-room can turn out a maximum of forty meters put through the "Standard Test" per day. This exceeds the number of meters that can be repaired in the shop each day and, therefore, the testing equipment is ample.

Private meters are sent in for test and repair from time to time. These meters range from cold water meters sent in from other towns and villages to hot water and beer meters from private industry.

A complete record of work done in the test-room is kept from day to day and up to December 31st, 1945, the record stands as follows:

Meters Tested, for Installation	Meters Rejected	Meters Tested, Before Adjustment	Summer Service, Trial Tests	Private Meters Tested	Grand Total of Tests
36,092	17,822	39,964	1,503	317	95,698

Of the 36,092 meters tested for re-installation 12,335 were repeats. Therefore, in the past 11 years, of

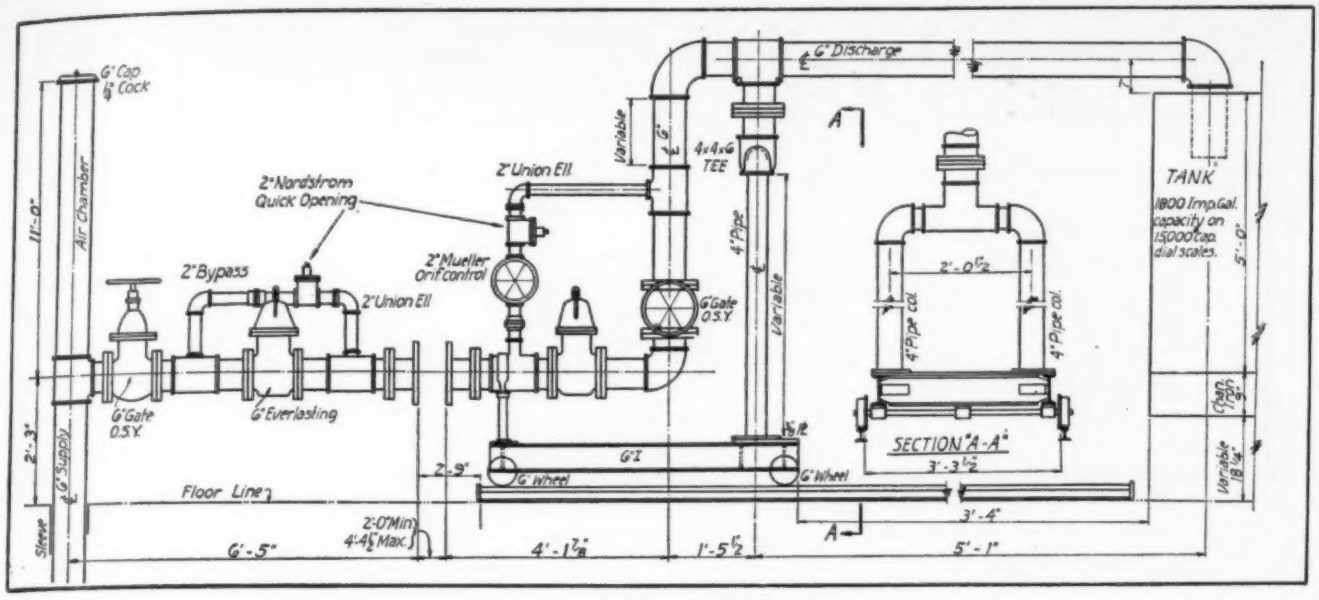


Fig. 13—Meter Test Machine for 3 in., 4 in. and 6 in. Meters.

the present total of 41,538 meters, 23,757 have been put through the Standard Test at least once. A total of 17,781 still need to be brought up to standard.

Meter Repair Room

The Meter Repair Room is equipped with work benches for each operator with a slop sink between each two benches, with hot and cold water. Each bench is equipped with a chain vise and the necessary small tools for meter repairs.

The foreman's bench is equipped with "go" and "no go" gages for the various meter parts.

A central bench is equipped with a motor driven vertical drill, and motor driven grinder, and a motor driven facing plate, and a large vise. A remotely situated bench is used as a paint bench. All worn meter parts such as intermediates and chamber parts, are removed and sent to the machine shops for re-conditioning.

The proper fitting of the hard rubber piston in the chamber is a matter of experience and a good mechanic soon acquires this skill by touch, by blowing through the assembled meter and by observation.

We have discontinued the use of the acid bath for cleaning meter parts and now rely on thorough brushing and hot water only.

(Fig. 14 shows the lay-out of the Meter Shop.)

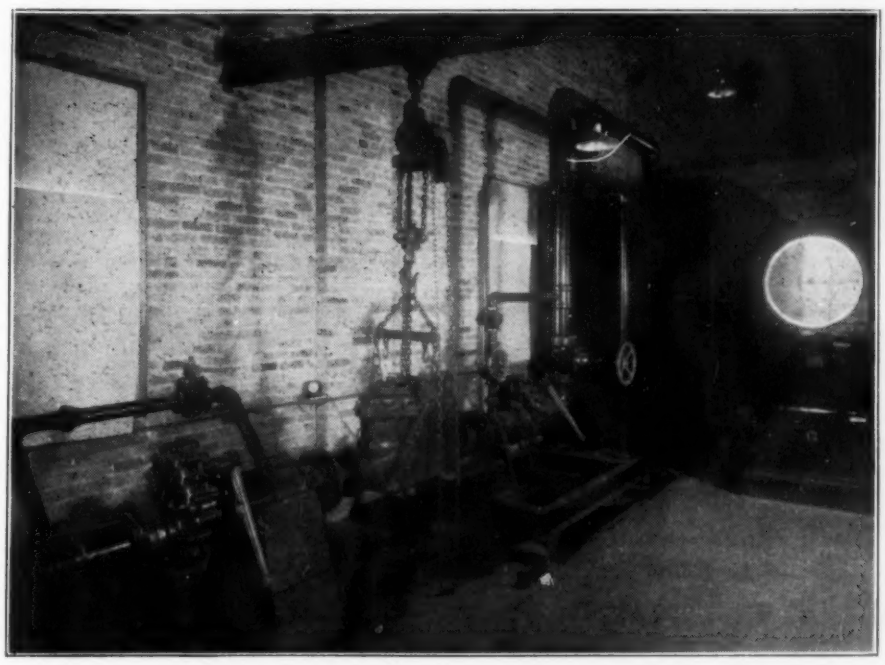
Cost of Removing, Re-installing And Repairing Meters

Prior to 1934 meters were only removed from service when they failed to operate. Some meters had been in service from 20 to 30 years without examination and repair. Hence, when the policy of removing and testing at least once in 7 years was adopted it was found that the meters removed were in bad shape and required extensive, costly repairs.

Our repair costs were greatly in excess of costs reported elsewhere in the technical press and we decided in 1941 to determine whether this excess cost was due solely to the fact that proper meter maintenance had not been given during past years or whether all the cost factors had not been included in published articles. Our conclusions were that part of Winnipeg's "excess" cost was due to improper maintenance in the past, and part was due to some factors not being taken into account in published figures from elsewhere.

This study was a co-operative one, carried out by the City and the Greater Winnipeg Water District and is being included at the suggestion of L. R. Howson, of Alvord, Burdick and Howson, Consulting Engineers, Chicago.

Mr. Howson felt that this study revealed that all the factors in the cost of meter repair, removal and replacement had not been taken



Large Meter Testing Machine
(Water is weighed in 1800 gal. tank.)

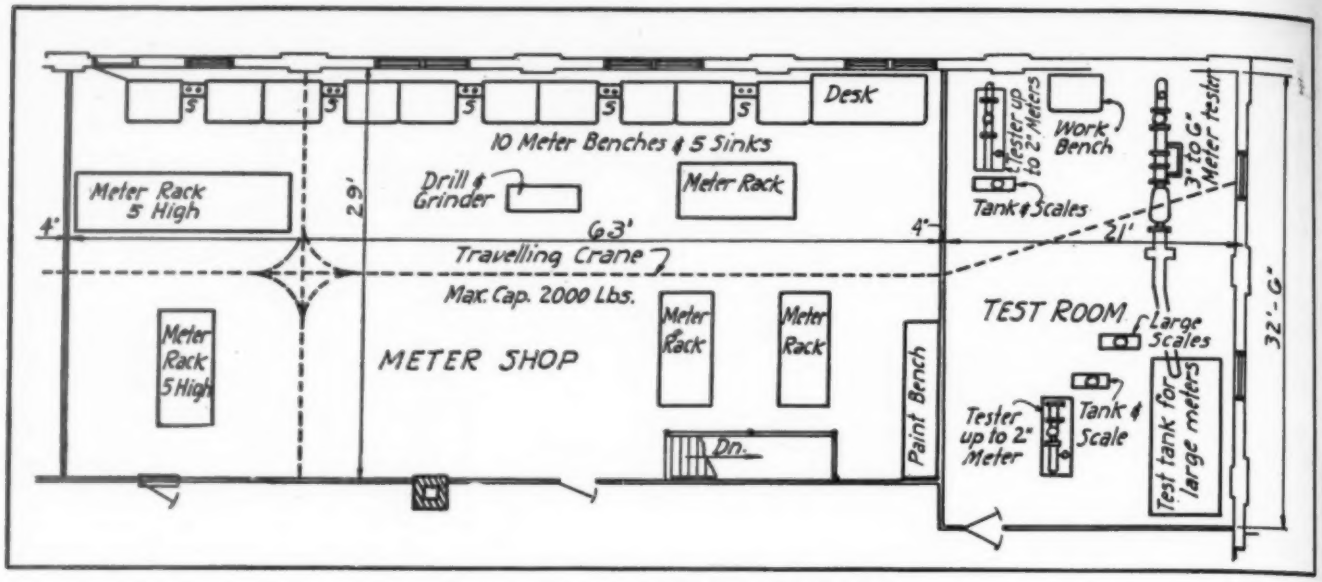


Fig. 14—Layout of Winnipeg's Meter Shop.

into account in the past and that this study would encourage analyses by other interested parties and give a better appreciation of the real cost of maintenance of meters.

The following data is the product of the study made by Winnipeg in 1941, reduced to tabular form. This study covers the repair of 2968 meters of 5/8-in. size.

EXHIBIT "B"

Cost of Labor at Repair Bench:

Labor on 5/8" meters $4,445.64
Compensation @ 2½% 111.14
$4,556.78

Average cost per 5/8" meter $\frac{4556.78}{2968} = \$1.54$

Cost of Material:

Total cost $9,366.78

Average cost per 5/8" meter $\frac{9366.78}{2968} = \$3.16$

Cost of Testing:

Tests made before repairing 2968
Tests made after repairing and found correct 1846
Tests made after repairing and rejected 1122
Tests made after rejection, repaired and found correct 1122
Total number of tests on 5/8" meters 7058
Total number of tests on all meters 8352
Cost of labor and compensation for 8352 tests $1,894.29
37 of these tests were made on 3" and 4" meters and required an average of 4 hours per test.
Labor plus compensation for 1 hour ..... $ 0.8216
Labor cost for 37 meter tests 37 × 4 × .8216 ..... 121.60
Remaining tests, i.e., 8315 tests cost 1,772.69

Average cost per test $\frac{1772.69}{8315} = \$0.213$

Average number of tests per correct 5/8" meter $\frac{7058}{2968} = 2.378$ tests.

Cost of testing per 5/8" meter—2.378 × .213 = $0.506

Cost of Exchanging:

Remov. and resetting are considered to be 2 operations.
Labor for 6928 operations $4,816.61
Compensation @ 2½% 120.41
Total cost for labor $4,937.02

326 of these operations were on 163 meters of large size and required 378 hours @ .8216 .... $ 310.56
Hence labor cost for 6602 operations $4,937.02—$310.56 ..... 4,616.46
1 truck trip = 2 operations and costs 0.75
Trucking cost = 6602 × ½ × .75. 2,475.75
Total cost for 6602 operations $4,626.46 + $2,475.75 ..... 7,102.21

1 operation costs $\frac{7102.21}{6602} = \$1.08$

Total number of meters exchanged (includes 300 new meters) 3,923
Large meters 163
Small meters 3,760
3760 meters required 6602 operations.

1 meter required operations. $\frac{6602}{3760} = 1.756$

Hence cost per meter—1.756 × $1.075 = $1.89

Cost of Miscellaneous Labor:

This includes cleaning, stripping fittings, cutting union and tail-piece washers, shop clerical work, etc. Most of this is done by apprentice labor and casual labor.
Cost plus compensation $1,674.25

Average cost per meter $\frac{1674.25}{3623} = \$0.46$

Cost of Painting:

Labor plus compensation ..... $ 695.14
Material 130.50
Total ..... $ 825.64

Average cost per meter $\frac{825.64}{3623} = \$0.23$

Cost of Stores:

Storekeeper's time $1,656.00
(About 60% of his time chargeable to meters) ..... $ 993.60
Compensation 24.94
Total $1,018.54

Cost per meter $\frac{1018.54}{3623} = \$0.28$

Cost of Administration:

Total Office Expense $19,640.30
Total number of men in Water Works Operating Department 113
Number of these on meters 12.79
Hence Office expense for meters $\frac{12.79}{113} \times 19640.30$ ..... $ 2,223.00

Cost per meter $\frac{2223.00}{3623} = \$0.61$

Cost of Interest and Depreciation on Building and Machinery:

Total floor space, square feet 8469
Floor space devoted to meters, sq. ft. 3711
Hence 44% of building cost and depreciation is chargeable to meters.
Cost of building $32,177.02
Interest plus depreciation 4½% + 2½% = 7% 2,252.39
44% of this is chargeable to meters 991.051
Cost of machinery 3,408.35
This includes: racks, benches, trays, vise, 3 testing units, 3 scales, electric drill, grinder, flow gauges, etc.
Interest and depreciation 4½% + 10% = 14½% 494.211
All of this is chargeable to meters.
Total—$991.051 + $494.211 ..... 1,485.262

Average cost per meter $\frac{1485.262}{2623} = \$0.41$

Cost of Building Maintenance:

Total cost $2,377.06
This includes water, light, heat, etc. 44% of this is chargeable to meters 1,045.90

Average cost per meter $\frac{1045.90}{3623} = \$0.29$

Cost of Supervision:

Total cost $1,639.98

Average cost per meter $\frac{1639.98}{3623} = \$0.45$

Summary:

Labor at repair bench	$1.533
Material	3.159
Testing	.506
Exchanging	1.888
Miscellaneous labor	.462
Painting	.228
Stores	.281
Administration	.611
Interest and depreciation on building and machinery	.409
Building maintenance	.288
Supervision	.452
	$9.817

Hence the average cost of repair for each of 2968 5/8" meters in 1941 was, roundly $9.82

Since the year 1935 an average of 9.41% of the total number of 5/8" meters owned have been repaired each year.
If 9.41% are repaired in 1 year then 100% are repaired in $\frac{100}{9.41} = 10.62$ years.

Thus on the average, each meter must be repaired every 10.62 years at an average per meter cost of... $9.82

Therefore, per year costs $\frac{9.817}{10.62} = \$0.924$

Hence, overall cost of repairing and testing 5/8" meters in Winnipeg averages very close to 92½ cents per year per meter.

PRE-DETERMINING EFFECTIVE DOSAGE OF COPPER SULPHATE IN ALGAE CONTROL

A Simple and Practical Laboratory Test Developed for This Purpose

By WILLIAM D. MONIE
Superintendent
COMMONWEALTH WATER CO.
SUMMIT, N. J.

EVERY engineering problem regardless of its complexities is solved by a common sense application of fundamentals. The problem of algae control is no exception and must be solved by the common sense application of fundamentals pertaining to this problem. It is with these fundamentals which we call the A, B, C of algae control that this paper is concerned.

The Author

Canoe Brook Reservoir

The supply at the Canoe Brook station of the Commonwealth Water Company is derived from a combination of artesian well water and a filtered surface supply. The surface water is pumped from a brook during wet seasons and stored in a reservoir approximately 204 acres in area, having an average depth when full of 11 ft., and a maximum capacity of 735 mg. In an average summer this reservoir constitutes a constantly decreasing but fluctuating volume of water, entirely exposed to light, with water temperatures reaching 80 degrees F.

The reservoir of the Commonwealth Water Company presents three features which make the control of algae especially difficult. With a maximum depth of only 11 ft. when full, it cannot stratify during the growing season, so the nutrients available for algae development are used over and over again giving maximum crops. Second, light at all times reaches the bottom where dormant stages of algae lying on the mud are quickly stimulated to activity whenever temperature and other factors are favorable. Finally, the reservoir is subject to marked fluctuations in its level. In consequence, the small bays and inlets, which are often the chief breeding grounds for objectionable algae, are frequently drained of their contents. Thus the entire reservoir is seeded again and again.

Algae control in this reservoir was indeed a problem. Records prior to 1939 show that it was not an uncommon occurrence to experience difficulty from luxuriant growths of algae, especially Anabaena and Aphanizomenon. In 1939, despite frequent treatments with copper sulfate from February through October, taste and odor trouble occurred in October because of abundant growths of Anabaena and Aphanizomenon.

A detailed study was then made of the A, B, C's of algae control with copper sulfate with especial consideration of our problem.

THE A, B, C, OF ALGAE CONTROL

A—The ability to determine when it is necessary to treat a supply.

B—The ability to determine the correct amount of copper sulfate to apply when treating.

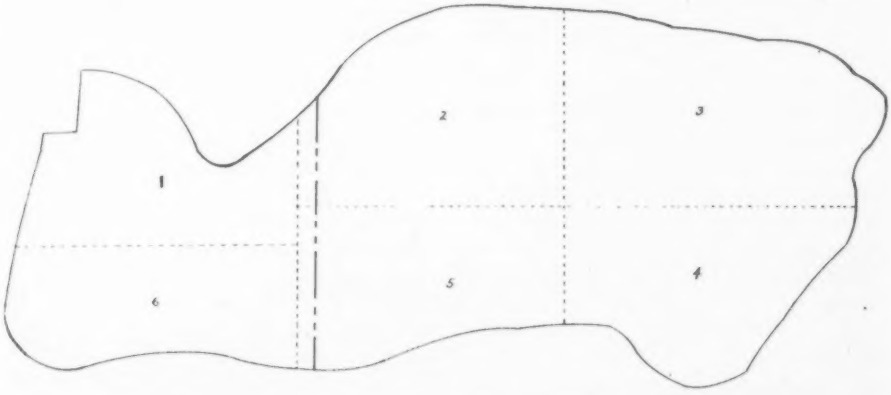
C—The ability to apply the treatment so that uniform distribution of the copper sulfate is obtained.

When to Treat

In determining when it is necessary to treat a supply, the most important governing point is a recognition of the fact that one must realize copper application is a preventive measure rather than a cure. Therefore, never wait for consumer complaints before treating, treat in ample time to *prevent* the complaints.

The best method of determining when it is necessary to treat a supply is by microscopic examination. When an organism is growing to such a point that it may cause trouble, daily microscopic examination and count should be made of samples taken directly from the reservoir. From the count and speed or rate of growth, it can be determined when the supply should be treated.

There are two points in the above paragraph which should be stressed: 1—Samples should be collected directly from the reservoir for microscopic examination. If samples are collected from a main, or after pass-



Diagrammatic Sketch of Canoe Brook Reservoir

The dotted lines show how reservoir is sectioned for purposes of sampling water and applying copper sulfate in correct proportion to water depth and algae concentrations. During algae growing season each section is sampled daily and given microscopic examination—believing that the old adage, about an ounce of prevention being worth pounds of cure, holds nowhere more pronouncedly than in algae control.

age from a pump, delicate organisms are broken up and some become unrecognizable. 2—In the growing season daily microscopic examinations must be made. It is surprising how rapidly organisms increase in number when growing conditions are ideal. It is not uncommon to have an organism more than triple its numbers within one to two days.

From experience at the Canoe Brook reservoir certain upper limits of safety, beyond which treatment was necessary, were determined for each organism. These are—

Organism	Count*
Asterionella	1,000-1,200
Mallomonas	800-1,000
Anabaena	600- 800
Aphanizomenon	300- 600

*Total number of organisms in ten fields at a magnification of 100x.

It was decided to apply copper sulfate only when an organism reached these limits, as it had proven uneconomical to attempt control when the organism is just starting to increase.

Keep an Eye on the Thermometer

The growth of different types of organisms can be anticipated by the temperature of the water, especially surface temperatures. According to Nelson[2], "Approximately twenty years ago, Doctor Setchell, Botanist of the University of California, pointed out that there are definite ranges of temperature within which various flowering plants begin to grow and higher ranges at which they will flower. These critical temperatures were found to lie close to 5°, 10°, 15°, 20°, and 25° C., (41°, 50°, 59°, 68°, and 77° F.) His studies showed that as the temperature passed the critical point, certain species were suddenly stimulated to activity. Hydrobiologists working with algae and protozoa are finding similar critical temperatures. Owing to the more gradual temperature changes which occur in the water, these ranges are more easily recognized and delimited than is the case with land plants."

It has been our experience that different species of algae have started to grow at these temperatures. Therefore, as the temperature of the water reaches these critical temperatures get out your microscope and keep a close watch on the algae growth.

How Much Copper to Apply

It was with this factor, how much copper sulfate to use in treating, that we experienced the most difficulty. Many times what appeared to be an effective treatment three days after the application of the salt found an aftergrowth of the same organism within a week of treating that reached greater numbers than were present before the sulfate was applied.

Many Factors Govern Dosages

In regard to the question of the amount of copper sulfate to use in treating a supply, Hale[1] states, "Experience differs with waters of different composition, with temperature and with the amount of organism present as to the right dosage to apply for each organism. It is a waste of chemical to apply an insufficient amount. If a smaller dosage fails, the entire larger dosage must be applied at one time."

Therefore, it is *a waste of chemical to apply an insufficient amount*, just as it is a waste to apply an excess amount.

We used the table based on data by Moore and Kellerman, Whipple, and others[1] as a starting point, and attempted to apply it to conditions existing at our plant. However, one of the organisms with which we experienced considerable difficulty was Aphanizomenon. The table gave a range of 1.0—4.2 pounds per mg. for the control of this organism. Furthermore, past experience showed that treatments of 1, 2, 3, and 4 pounds per mg. had all been effective for the control of Aphanizomenon at one time or another. We realized that if we treated for Aphanizomenon with 1 pound of copper sulfate per mg. when 4.2 pounds per mg. might be needed, the 1 pound per mg. treatment would be wasted, since the 4.2 pounds per mg. must be applied at one time to be effective. Likewise, if the 4.2 pounds per mg. was used and 1 pound per mg. would have done the work, then 3.2 pounds per mg. would be wasted.

With so many factors influencing the amount of copper sulfate to use in treating a supply, algae control would certainly be much more scientific if we had a test that would allow us to say definitely how much copper sulfate it was necessary to use to satisfy all conditions. In September of 1940 the author devised a simple, practical, laboratory test to determine the amount of copper sulfate necessary to use in treating a supply of water regardless of its temperature and composition and, within certain limitations, regardless of the type and amount of organism present.

THE "D. M." TEST

It was found that the addition of certain amounts of copper sulfate to water containing algae resulted in an increase in the alkalinity. The amount of copper sulfate needed to bring about this increase in alkalinity was the correct amount to use in treating. After much experimentation the following test was developed.

The equipment and chemicals necessary for the test are as follows:

a. Six 50 ml. nessler tubes.
b. A copper sulfate solution of a strength that 2 ml. added to a liter of water equals a copper sulfate treatment of one pound per mg.
c. Phenolphthalein indicator.
d. N/88 sodium hydroxide.

To make the copper sulfate solution mentioned in b, dissolve 0.6 gram of the copper sulfate you use in 1 liter of distilled water. Dilute 100 ml. of this solution to 1 liter with distilled water. Two ml. of this final solution per liter of sample equals one pound of copper sulphate per mg., or 0.1 ml. per 50 ml. of sample equals one pound of copper sulfate per mg.

Test Procedure

In each of six 50 ml. nessler tubes A, B, C, D, E and F, 50 ml. samples of the water to be treated are placed. To tube A, add 0.1 ml. of the copper sulphate solution (b) to equal a treatment of 1 pound per mg.; to tube B, 0.2 ml. of solution (b) is added to equal a treatment of 2 pounds per mg.; to tube C, 0.3 ml. of solution (b) is added to equal a treatment of 3 pounds per mg.; to tube D, 0.4 ml. of solution (b) is added to equal a treatment of 4 pounds per mg.; to tube E, 0.5 ml. of solution (b) is added to equal a treatment of 5 pounds per mg. To tube F, no copper sulfate is added. These samples are then mixed by corking and inverting approximately thirty times simultaneously.

To the nessler tube F (the blank sample), phenolphthalein indicator is added. If there is a negative amount of free carbon dioxide present, enough indicator is added until there is a faint but distinct pink color. Then the same amount of phenolphthalein is added to each of the other samples. The samples are compared and the tube with the deepest color is the tube containing the sample to which has been added the correct amount of copper sulfate to use in treating.

Influence of Carbon Dioxide

If there is free carbon dioxide present (and there usually is), three drops of phenolphthalein is added to each of the six samples in the nessler tubes after they have been mixed with the various amounts of solution

(b) as described above. Then N/88 sodium hydroxide is added to the nessler tube F (the blank sample) until there is a faint but distinct pink color. The same amount of the sodium hydroxide is then added to the other five samples and the tubes are compared for color. The deepest color will be found to be in the tube containing the sample to which the most effective and economical amount of copper sulfate to use in treating has been added.

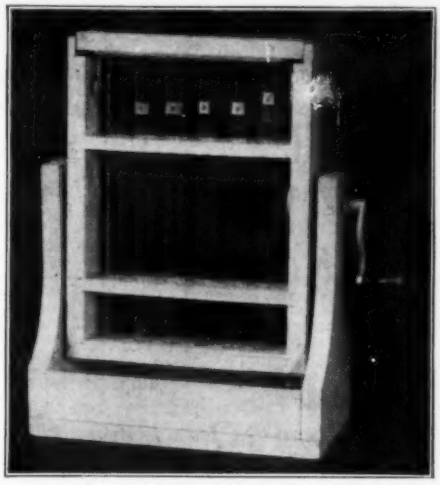
This test is practically the same as a free carbon dioxide titration. However, in the algae test it is simpler to have both the phenolphthalein and the sodium hydroxide in dropper bottles, as the equal amounts can be easily added to the sample tubes by counting the drops. N/88 sodium hydroxide is used simply because finer control can be maintained on the color. In waters with considerable carbon dioxide, N/44 can be used just as effectively.

It is important to note that the tube with the deepest color is always darker than the blank sample. Therefore, at the correct dosage of copper sulfate the water is more alkaline than it was prior to the addition of the salt. This result is clearly shown in the test irrespective of the fact that phenolphthalein is not a sensitive indicator. The puzzling factor of the entire test is the fact that at a certain concentration of copper sulfate dosage the alkalinity is increased, and then with an excess of copper sulfate the alkalinity decreases to approximately the same point as it was in the blank sample. Therefore, the color in the tubes rises gradually with the dosage increase and after reaching a maximum the overdosage causes a lessening color development.

When the "D. M." Test was first developed the author used a mixing machine with liter samples instead of the nessler tubes. However, the reaction in the test is so fast that the results can be obtained quicker with equal accuracy using the nessler tubes.

The accompanying picture illustrates a simple gadget made by the Honesdale Consolidated Water Co., Honesdale, Penna., for use in inverting the Nessler tubes for mixing purpose. Although such an instrument is handy, accurate results are obtained when the mixing is done by hand.

If more than one type of organism is present in sufficient numbers it is possible to get two or more treating points by the D. M. Test. For example, Anabaena and Aphanizomenon were present at the same time in the water at Canoe Brook reservoir. The D. M. Test showed two distinct treating points, two pounds per mg. and four pounds per mg. To use two pounds per mg. would have been a mistake as only the Anabaena would have been destroyed which would leave conditions perfect for the rapid increase of the Aphanizomenon.



Tube Inversion Rack Used in "DM" Test
(Honesdale, Pa., Water Co.)

Proper Method of Copper Application

Proper distribution of the copper salt through the reservoir water is important to successful algae control. Knowledge of the first two steps for algae control—when to treat, and how much salt to use in treating—would be of no value without proper application of the chemical. For example, if a four-pound per mg. treatment of copper sulfate is necessary, then the salt must be applied so that the water in all parts of the reservoir has received approximately a four-pound per mg. treatment. The deeper parts of the reservoir must receive in proportion more salt than the shallow parts. If this is not done, some portions of the water will be undertreated and the algae not killed in these parts will remain to re-seed the reservoir.

Here again, a detailed study of conditions of each reservoir must be made and the method of application decided upon after careful deliberation. In the majority of lakes the best method of application is by dissolving the copper sulfate from burlap bags or perforated boxes attached to a boat. However, in some lakes and for certain types of algae some other method of application such as spraying either a solution of copper sulfate or broadcasting the pulverized dry salt may be more practical.

Knowledge of Reservoir Topography Important

In order to obtain proper uniform distribution of the chemical a knowledge of the reservoir bottom topography is an important consideration. If you do not have a contour map of the reservoir bottom, make one. The points for preparing such a map are easily obtained by soundings from a boat, or from the ice in northern regions.

When the reservoir bottom topography is known it is a simple matter to section the reservoir into areas of approximately uniform depth. With this knowledge it is possible to apportion the salt in treating so that equitable application can be planned and made. In deep reservoirs usually only the top twenty feet need be considered in treating.

METHOD OF APPLYING CHEMICAL

At the Canoe Brook reservoir the treating is done by means of a boat propelled by an outboard motor. The chemical is placed in two burlap bags, one on each side of the boat, suspended from frames so that addi-

Method of Coppering
Row boat with outboard motor and copper sulfate applied from burlap bags, with quantity in the bags determining the dosage.

tional salt can be added to the bags to keep the amount of salt exposed to the water uniform. The strength of the treatments is regulated by the level of sulfate carried in the bags.

The conventional strip method is used in treating. After experimenting, the strips now used are approximately forty feet wide. This width of strip allows the reservoir to be treated in an eight hour day with one boat. The same width of strips are adhered to regardless of the amount of salt per treatment, the amount of salt going into solution depending upon the amount exposed to the water.

In a case where a reservoir is so large that strips over 100 feet are necessary, more than one boat should be used in treating.

Results

The following table illustrates the results obtained over a seven year period from 1939 through 1945 at the Canoe Brook reservoir. In five of these years the copper dosage was determined through use of the D. M. Test.

Year	Treatments	Lbs. $CuSO_4$
1939	37	33,750
1940	7	11,250
1941	8	14,350
1942	3	6,200
1943	2	3,700
1944	3	5,200
1945	3	5,200

As shown by this table gratifying results were obtained by practical application of the fundamental A, B, C of algae control. From the last treatment in 1940 the D. M. Test was used in determining the amount of copper sulfate to use in treating.

There has not been a treatment where the amount of salt used was determined by the D. M. Test that was *not* successful. Additional success since 1941 is believed to be due to changes made in applying the fundamentals of when to treat and how to apply the salt.

One interesting observation during systematic use of the D. M. Test is that the amount of salt necessary to destroy certain organisms increases as the number of the organisms present increases until a certain point is reached and then the amount of salt required decreases as the organism continues to increase in numbers. This circumstance is unexplained.

References

(1) Hale, Frank E., "The Use of Copper Sulphate in Control of Microscopic Organisms." Phelps-Dodge Refining Co., New York. (Revised 1935).

(2) Monie and Nelson, "Algae Control," *Jour. A.W.W.A.*, April, 1941.

First Inter-American Sanitation Conference

To Be Held in Rio, June 10-15

The Pan American Sanitary Bureau and the Institute of Inter-American Affairs are jointly arranging the first regional conference on sanitary engineering in Latin America. This conference is scheduled to be held in Rio de Janeiro, Brazil, the week of June 10, 1946. It is planned that Sanitary Engineers from Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, Uruguay and the United States of America will participate in the conference. The objectives of the conference are:

1. Advancement of the profession of sanitary engineering.
2. Exchange of scientific data and ideas in the development of sanitary engineering in the Americas.
3. To promote the development of standards for sanitation in international travel.
4. To accelerate the development of sanitation in the Americas as an important factor in subsequent economic development.
5. To create a better understanding between the engineers of the American Republics.
6. To organize a permanent Pan American organization of sanitary engineers.

The Ministry of Health and Education of Brazil will act as host to this conference, to which all engaged in public health engineering, water supply and sewage disposal are invited.

For further information or hotel reservations address Edmund O. Wagner, Inst. of Inter-American Affairs, Avenida Rio Branco 251, Rio de Janeiro, Brazil—or Captain D. L. Snow, San. Engr., Pan-American Sanitary Bureau, Pan-American Bldg., Washington, D. C.

Later in the year a similar conference will be held in Caracas, Venezuela, for the benefit of Central American engineers, chemists and plant managers.

New Dallas Consulting Engineering Firm

Chappell, Stokes & Brenneke

Announcement has been received of the formation of a partnership by Frank W. Chappell, R. C. Stokes and A. M. Brenneke under the firm name of Chappell, Stokes & Brenneke, Consulting Engineers, at the Burt Bldg., Dallas, Tex. A. M. Brenneke is the same "Gus" Brenneke, former city engineer and superintendent of Water at Denison, Tex., later engineer in charge of salt water pollution investigation for the Texas State Dept. of Health, who went to Venezuela last year as an engineer in the Federal Dept. of Sanitary Engineering of Venezuela.

A. M. Brenneke

The new firm will specialize in general civil engineering practice for counties, cities and other public agencies and for commercial and industrial interests, structural design service for architects, engineering investigations and reports.

Long Beach Annual Report

Two of the most interesting features of the Annual Report (1944-45) of the Water Dept., City of Long Beach, Calif., are the map showing the water supply system, and the chart showing how the dollar of gross income was distributed.

With a total gross income of $1,402,535.60 and expenses including bond redemption of $1,007,695.65, it was apparent that the net earnings after depreciation of bond redemption were almost $400,000. Operating expenses consumed 45 cents out of a gross dollar, fixed charges 13 cents, depreciation 13.8 cents, net earnings 28.2 cents. Of the operating expenses, 10 cents went to source of water supply, 7 cents to purification and pumping, 14 cents to distribution, 7.4 cents to commercial cost, and 6.5 cents to administrative and general miscellaneous expenses.

This annual report is complete with charts, diagrams and tables indicating all information on the operation of the Long Beach water supply system. One chart shows the number of miles of mains installed for each year from 1935 to '45, the number of new services installed, water pumped and purchased in millions of cu. ft., and the total gross income.

The largest number of miles of main (23.1) was laid in 1941-42 when the most new services were installed (2,490), but new service installations in 1944-45 ran a close second (2,418). Total pumpage and gross income were highest during the past year. Some water (2.5 to 17 per cent) has been purchased during the last three years to meet the total demand.

N. Y. SECTION SPRING MEETING DRAWS 225 TO ELMIRA

A TOUR of the water supply facilities and the famed Harris Hill Glider Field, songs by the Cornell University Glee Club and

Acting Chairman
Wallace J. Miller
Superintendent
Water Dept.
Ossining, N. Y.

AWWA Director
Hugh S. Dewey
Genl. Manager
West'n N. Y. Wtr. Co., Buffalo

the Elmira Girls' School Choir, and motion pictures were the entertainment features furnished the 225 registrants at the Annual Spring Meeting of the New York Section of AWWA in Elmira on March 28 and 29.

A Veteran Retires

Although the regular election does not take place until the Fall meeting, Lewis Smith, Supt. of Water at Rochester, was elected to fill the unexpired term of trustee left vacant by the resignation of William H. Clark, who has just retired as Superintendent of Water in Avon, N. Y. "Bill" Clark retires after 43 years' service in the water works profession and 30 years' membership in AWWA. Clark's place in Avon will be filled by his son, William, Jr., recently returned from service.

Evolution of Elmira Water Works

Illustrating his talk with slides, **James M. Caird,** Consulting Chemist of Troy, N. Y., traced "The Evolution of the Elmira Water Works." A brief resume of the history of the Elmira Water Supply as given by Mr. Caird follows:

1858—First Water Works on Seeley Creek,—small dam or bulkhead and wooden pipe section still known as "Bulkhead" on south side of river.

1860—Elmira Water Co. built what is now known as the small filtered water reservoir, capacity about 3½ million gallons. This was supplied with water from Hoffman Creek and was used until 1870.

1870—Elmira Water Works Co. was formed, the Diven family being the prime movers and owners.

1870—The Hoffman Creek storage reservoir dam built, capacity

Trustees
J. McClure Wardle
Supt. Wtr. & Swge.
Hudson, N. Y.

Lewis A. Smith
Supt. of Water
Rochester, N. Y.

113 mil. gal. Drainage area about 4½ sq. mile. Forest started on property owned by Board. During 1945 this reservoir provided 1,031,000,000 gallons or 46.1 per cent of the supply. Since 1897 this water has been filtered. Elmira was growing and this source of supply was not sufficient for the needs.

1883—Infiltration gallery installed on an island in the river and a pumping station placed in operation. Gallery proved inadequate and in 1899 river intake and a large 10 mil. gal. steam pump were installed. This station has now been completely electrified, the latest pump installed having a capacity of 10 mil. gal. with

Host
John G. Copley
Gen. Manager
Water Board
Elmira, N. Y.

Secy.-Treas.
Rollo K. Blanchard
Vice-President
Neptune Meters
New York City

two standing by of 6 and 7 mil. gal. capacity.

1896—Typhoid fever epidemic—370 cases, 36 deaths. About 1,000 wells in use at this time. Investigated.

51 per cent claimed to have used nothing but city water.

34 per cent claimed to have used nothing but well waters.

7 per cent claimed to have used mixed waters.

6 per cent claimed to have used imported water.

Later State examined 100 wells and found B. Coli in 65.

1897—Rapid Sand Filters installed, high type Jewell Filters. Owing to patent litigation, no coagulant was used until 1898. The patent was known as Hyatt's and covered the use of alum and sulphate of alumina in water coagulation. Original plant 18 units, 13 ft. inside dia. Plant has been increased twice and now consists of 24 units, rated capacity 8 mil. gal. Original units cedar and all of the inner tanks are still in use, although it has been necessary to re-

James J. Murphy, Meter Supt. at Elmira, showing a Jap meter to Wm. H. and Reilly Clark of Avon, N. Y.

Hon. Emory Strachen, Mayor of Elmira, making the luncheon address.

Headquarters, The Mark Twain Hotel, carrying Elmira's sign of welcome.

Pres. Leonard Thompson down from St. Paul to address the N. Y. Section on "AWWA Today."

And later—The "Skipper" finds a moment of relaxation and time to scan the news.

"Art" Clark, Secy.-Mgr.
W. & S. Wks. Mfrs. Assn.
New York, N. Y.
and
"Reg" Hayes, Sales Mgr.
Hydraulic Devel. Corp.
New York, N. Y.

Orrie L. Allen
Foreman
and
Leland A. Welker
Supt.
Water, Lt. & Sewerage
Penn Yan, N. Y.

Everett Rowley, Supt.
Long Island Water Co.
Lynbrook, N. Y.

Pres. Leonard Thompson
Jim Wheelin
Neptune Meter Co.
New York, N. Y.

Geo. J. Natt, Engr.
Public Service Comm.
Albany, N. Y.
and
Charlie Cox, Distr. Mgr.
McWane C. I. Pipe Co.
New York, N. Y.

Bert Seeholzer
Northrop & Co.
New York
and
John D. Hall
Supt. of Filtration
Batavia, N. Y.

place the outer tanks, some of which were in use over 40 years. Strainers have been removed and replaced with perforated pipes.

1911—High pressure pumping station and reservoir installed, resulting in pressures of 70 pounds or over in downtown sections. Reservoir capacity 5 mil. gal.

1915—City purchases water company and supply.

1930 — Spillway on reservoir razed, forest planted on property. Aerators were installed—inlet to reservoir changed—increasing pH from 6.8 to 7.4 improved taste; open reservoir releases excess air.

1931—Covered balancing reservoir installed on south side, capacity 1½ mil. gal.

1938—Coagulation basin was installed—owing to ice and algae troubles this basin was covered in 1939. Water enters into mixing boxes containing rotary paddles and has from 15-20 minutes' stirring, flowing over a weir into the basin proper. Channels are of increasing widths, thereby decreasing the velocity. Also some over and under baffles in basin. There has always been a chemical and bacteriological laboratory at the plant since 1898. Modern equipment is added from time to time. Sulphate of alumina and chlorine are added to the water before it enters the mixing boxes. Sufficient chlorine being added to carry a "residual" through the basin. Chlorine assists in the formation of the "floc." Ammonia is added to the final effluent and a "residual" is maintained throughout the distribution system.

James M. Caird
Consulting
Chemist & Bact.
Troy, N. Y.

E. W. Ewig
Cons. Engineer
W. S. Lozier, Inc.
Rochester, N. Y.

Payne Dean
President
Payne Dean & Co.
Madison, Conn.

Donald E. Stearns
Prof. Civil Eng.
Syracuse Univ.
Syracuse, N. Y.

Programmers

TYPHOID FEVER DEATH RATE PER 100,000 POPULATION RATE

Before filtration 3 years	
1895-97	78.8
After filtration 5 years	
1898-02	41.6
1903-07	41.7
1908-12 (hypo-chlorite used late 1909)	24.0
1913-17 (liquid chlorine used in 1913)	10.5
1918-22	9.5
1923-27	2.1
1928-32	2.5
1933-37	2.5
1938-42	1.4
1943-44-45	0.0

In considering the apparently slow reduction in the Elmira typhoid fever death rate it must be remembered that there were about 1,000 wells in the city and educating the people to the dangers in using wells in populated districts has been slow.

Public Ownership of Elmira Water Supply

John G. Copley, General Manager of the Elmira Water Board, reviewed the "Financial Progress Under Public Ownership" at Elmira, beginning with the formation of the Water Board in 1913. In 1915 the Board purchased the assets of the Elmira Water Co. for $1,500,000. A profit on the sale of bonds of $41,000 was earmarked for the purchase of meters, and the Board actually started its operation of the supply with but $5,000 cash.

In the thirty years since that time,

"Bill" Fenger
Distr. Mgr.
Mathieson Alkali
New York, N. Y.

"Bob" Sawyer
Malcolm Pirnie
Engineers
New York, N. Y.

"Bill" McCaffrey
Supt.
Water Dept.
Oswego, N. Y.

Leo Desmond
Distr. Mgr.
Central Fdy. Co.
New York, N. Y.

Harry B. Miles
Gen. Mgr.
Water Board
Utica, N. Y.

Vernon Eager
Distr. Mgr.
"Infilco"
Buffalo, N. Y.

Gale Dixon
P. B. H. & McD.
Engineers
New York, N. Y.

P. S. Wilson, V. P.
The Gregg Co.
Glen Ridge, N. J.
and
W. D. Davy
Supt. of Water
Prattsburg, N. Y.

*Wm. H. Clark**
Superintendent
and
Reilly S. Clark
Asst. Supt.
Avon, N. Y.
*(*Retiring Vice Chmn.)*

F. B. "Red" Griffith
Field Engr., W. & T. Co.
Syracuse, N. Y.
and
L. J. Peck, Distr. Mgr.
Wallace & Tiernan Co.
Albany, N. Y.

J. E. Williamson, Dis. Mgr.
Rensselaer Valve Co.
New York
and
Wm. F. End, Gen. Mgr.
Ross Valve Co.
Troy, N. Y.

Chas. P. Baulsir
and
Gale Dixon
Parsons, Brinkerhoff,
Hogan & McDonald
Engineers
New York, N. Y.

the distribution system has been increased by 65 per cent, the number of services by 30 per cent, and the number of meters by 50 per cent.

In that same thirty years the indebtedness has been reduced to zero, the rates have been reduced by 12 per cent, and the consumer use has increased 4 per cent.

Waste water surveys are made every 10 years. Plans for plant expansion, improvement, or repair are programmed several years in advance, and the Board now has on hand $89,000 to cover the deferred plans of 1941-45.

Mr. Copley concluded his paper with three pertinent comments: (1) that municipal operation and public ownership are O.K. if operation follows the precepts of a private system operation; (2) a uniform system of accounts as developed by AWWA is best; and (3) good operation can be maintained only if out of date equipment is replaced.

New From Old Water Works

In the absence of **A. Bradford Squires,** his paper on "New From Old in Water Treatment Works at Williamson, N. Y.," was read by **E. W. Ewig** of Wm. S. Lozier, Inc., Cons. Engineers, Rochester, N. Y.

To keep pace with the war-time demands for water by the canning industry and an increased population, Williamson, N. Y., found it necessary to remodel its water plant. The modernized plant includes all of the latest features of filter plant design and the improved operation resulting therefrom is gratifying.

Between 1939 and 1943 the water consumption rose from 44 mil. gal. per year to 91 mil. gal. per year or more than a 100 per cent increase. Improvements to the system had been made between 1934 and 1941, but these were insufficient to meet the increased demand, and hence the need for further modernization.

Two old sedimentation basins

Simon P. Carman
Supt. & Engr.
Water and Sewage
Binghamton, N. Y.
(Leader of round-table and ?-Box)

Jack M. Diven
Distr. Mgr.
The Leadite Co.
Jackson Hgts., L. I.
(Chm'n Membership Committee)

that had never performed efficiently were converted into "Accelator" units and the equipment now provides automatic mixing, coagulation, and sedimentation in one-third of the time formerly required. Two new filters were constructed, using carborundum porous filter plate bottoms covered by a 27-in. layer of Anthrafilt. A Palmer filter wash system is provided in each filter.

Existing chemical feeding equipment was either modernized or replaced. Present equipment includes W&T chlorinators and Infilco dry feeders. Special attention was given to the selection of pumps and pumping equipment in order to reduce the equipment is by Ingersoll-Rand, high cost of pumping. Pumping Gould, and Worthington.

Improved operation resulting from these new features is readily apparent. Water going onto the filters from the "Accelator" unit has a turbidity of less than 4 ppm. Filter operation has improved markedly. Filter runs now approximate 120 hours or twelve times as long as before the changes were made. Although pumping now takes place against a 10 per cent greater head, the cost of pumping has been reduced by 3 per cent, and between 1940 and 1943 the total cost of pumping water dropped 12 per cent, but the amount of water pumped increased by 80 per cent. Payment for the improved plant is being made entirely from water rents.

Flow of Water in Pipes

In presenting some "Practical Considerations Governing the Flow of Water in Pipes," **Prof. Donald E. Stearns,** Prof. of Civil Eng., Syracuse University, said the most common method of determining distribution system flow is the hydrant flow test. This test consists of measuring the pressure at a flowing hydrant, using an accurate gage or preferably a pitot tube.

Inasmuch as hydrant diameters differ, the flow is affected and full consideration must be made of this fact in studying the problem.

When the data are collected on the

"Bill" Ryan
Sales Engineer
Stuart-Brumley Co.
Rochester, N. Y.

Herbert Bachelder
Engineer
Municipal Comm.
Herkheimer, N. Y.

Joe Harper
Distr. Mgr.
Rockwell Mfg. Co.
New York, N. Y.

F. B. "Red" Griffith
Field Engr.
Wallace & Tiernan
Syracuse, N. Y.

Nelson J. Wagner
Sales Engr.
Rust-a-Restor Co.
Rochester, N. Y.

N. L. Nussbaumer
Consulting
Engineer
Buffalo, N. Y.

John T. Connelly
Distr. Mgr.
Kennedy Valve Co.
Elmira, N. Y.

Elon P. Stewart (Trustee) Supt. Water Syracuse, N. Y.

Wm. F. End Gen. Mgr. Ross Valve Co. Troy, N. Y.

Alfred M. Roberts Pres., Wanakah Water Co. Wanakah, N. Y.

Ray Jerge "Curley" Rockwell Co. Buffalo, N. Y.

E. J. Rowe Supt. Munic. Util. Wellsville, N. Y.

hydrant flow test and the residual pressures are recorded for points at each end of the main to be tested, it is then relatively easy to compute the loss of head for the main. This calculation is "accomplished by an application of the Bernoulli Theorem which states that the sum of the velocity head, pressure head, and elevation head at the point most remote from the flowing hydrant is equal to the sum of the velocity head, pressure head, and elevation head at the hydrant, nearest the flowing hydrant, plus the loss incurred between the two points on the main."

Having determined this loss of head, it is possible to evaluate the friction coefficient "C." As the value of "C" decreases, the head loss increases. This relationship is shown in the following table developed by Prof. Stearns:

Value of "C"	*Head Loss in %**
120	71
110	84
100	100
90	122
80	151
70	194
60	250
50	362

*Where head loss for C = 100 is 100%.

The benefits of reducing head loss are apparent in decreased pumping costs and increased pressures in the distribution system. To make distribution flow studies is far more beneficial than to guess at "C" values.

While the Hardy Cross Method of making distribution studies is effective, it is highly involved. It is simpler to use the system of T. Francis O'Connor, where for calculation all pipe sizes are converted into a single pipe size and values are expressed for equivalent pipe lengths. Prof. Stearns prefers to evaluate in terms of a 12 inch pipe with a "C" value of 100.

Only through proper flow studies is it possible to make a revision of main systems with the most economical results.

Power Operation of Gate Valves

Without doubt, one of the most interesting papers of the technical sessions was the illustrated talk presented by **Payne Dean** of Payne Dean and Co., Madison, Conn., on the subject of "Power Operation and Maintenance of Large Gate Valves."

Pointing out the difficulties of closing large gate valves and the slow back-breaking work involved, Mr. Dean recounted some of the history of the development of a mechanical device for performing the job.

"The Golden Eagle"
(Adorns the first motor to replace the old pumping engine in Elmira's Pumping Station.)

Mr. Dean believes that the large valve is the forgotten valve of the industry and that if the water works man wants improvements in valves he must ask for them. Mr. Dean further suggested that the butterfly valve has many inherent advantages and that the water works association and valve manufacturers should sponsor a research organization with a testing laboratory to study and develop better valves for use on water mains.

ROUND TABLE AND QUESTION BOX

Under the leadership of **Simon P. Carman,** Supt. and Engr., Binghampton Water Works, a number of current topics and questions were discussed during the Round Table session.

Personnel Relationships

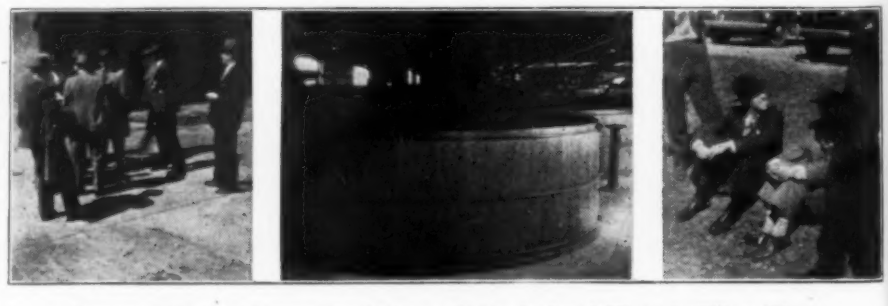
On the matter of "Personnel Relationships," **Miles** of Utica said that four service men had returned to their former positions, and two service men had been hired for new positions. The Utica Water Works has received few applications for positions from service men, and Mr. Miles wondered if it could be because of the mustering out pay or because of the unemployment insurance for 26 weeks.

Copley of Elmira said they couldn't find ex-service men, but **Wendt** of Rochester said they had had six applicants for two helpers' jobs. **Lamb** of Jamaica said that 35 out of 45 service men were back on the job; 25 of these have their old jobs and 10 have new jobs in the water works. Lamb's question is what to do with the temporary men who served while the service men were gone.

Nollett of Bath has difficulty in finding technical men, while **Hammel** of Long Island finds that some men want to come back but others are looking for jobs with higher pay.

Training Operators

Prof. M. L. Malcolm, Head of the Civil Engineering School at Cornell, told the audience that schools and colleges are so crowded now that it will be impossible to hold short schools for operators for at least another year.



Snapped During Inspection Trip to Elmira's Semi-Historic Filter Plant
(Old wooden tub filters with revolving cleaning rakes have given long service.)

Charles Cox, Chief of the Bureau of Water of the N. Y. State Health Dept., raised the question as to the possibility of using large filter plants in the state for short courses, especially for Saturday morning classes over a period of weeks. Mr. Cox pointed out that with the growth of Civil Service in the State, the Municipal Training Institute Schools are becoming more important, and there is a possibility of the development of a Civil Service Institute.

In reply to a question by **James M. Caird,** Consulting Chemist of Troy, Mr. Cox said that no license was being given to persons who pass Civil Service Examinations but Certificates of Operator Qualifications are given.

Impact of Labor Organizations

James Caird of Troy told of being asked to join a City Employees Union in one water plant for which he is the consulting chemist. **W. W. Brush** of New York City said that employers need a tribunal before which they can go to settle labor questions. **C. R. Cox** said no strikes had occurred in any New York water plants but at least one did occur in a city in the mid-west last year.

Housing Problems

R. Blanchard, Secy. of the Section, reviewed the Wyatt Housing program and said that it would be impossible for meter companies to supply meters for that program. Perhaps the answer will be to take out meters on services which use but little water and put the meters in the new homes. Mr. Blanchard expects some kind of housing bill as does every one else and said that there could be no civilian post war plans carried out if the housing program goes forward on a priority basis.

Leonard Thompson, Pres. of AW WA and Supt. of St. Paul, Minn. Water Works, said that the Civilian Production Administration Order No. 1 channels all critical building material to homes except materials needed for the construction of water mains, dams, etc. The order also sets a ceiling on the construction of utility structures. The water works industry is faced with the problem of having to service these new homes although it is impossible to obtain lead, and copper will probably soon go off the market. Mr. Thompson suggests that water works superintendents go to their congressmen and impress on them the need for these critical materials in the production and distribution of water.

John G. Copley, Gen. Mgr. of Elmira Water Board, emphasized the fact that our post war plans have now become post Post-War Plans, and Mr. Blanchard warned that if new homes are put on a flat rate, the supply may prove to be inadequate.

The question of rising costs versus static rates was brought up by **Yaxley** of Watertown, who cited figures on the matter. Whereas in 1937-38 the cost of operation was 59 cents per 1000 cu. ft. and the income was 94 cents, now the cost of operation has soared to 72 cents per 1000 cu. ft. while the revenue has dropped to 86 cents for the same volume. Obviously this condition cannot continue without a depreciation in the service rendered.

Corrosion Control

In one city chloramine treatment to prevent pipe line growth and tuberculation made it possible to maintain a "C" value of 140 to 135 over a period of seven years with cleaning required only once in 16 years whereas prior to chlor-ammination cleaning was necessary every 18 months and "C" values dropped to well below 100 between cleanings.

In another city, however, the use of chloramine treatment had no effect toward maintaining a high "C" value. In the latter case the soft water was corrosive and thereby reduced the carrying capacity of the line by causing tuberculation. In the former case it was a harder water and the decrease in carrying capacity was due to biological growths. Obviously, for different waters that present different characteristics, a single treatment may not be the answer. (G.E.S.)

Addison's Applied Hydraulics

The third edition of Herbert Addison's "A Treatise on Applied Hydraulics" has just been issued by John Wiley & Sons, Inc. This new edition not only is larger, containing additions of numerous explanatory notes and a substantial increase in the number and variety of examples, but it is also clarified and modernized. A revised up to date bibliography adds to its usability.

The book is designed for engineers in general, whose work is not directly connected with hydraulics and who must keep in touch with the main outlines of hydraulic practice. Any person who intends to specialize or now specializes in water supply, irrigation or construction of pumps and turbines will find this book of inestimable value.

Particular attention is given to the subject of frictional loss in open and closed conduits, pressure and thrust on immersed solids, water-hammer in pipes, pressure distribution on pump and turbine blades, and its relation to cavitation and suction lift. Part I is devoted to fundamental principles and Part II to practical applications.

This treatise on Applied Hydraulics is written by Herbert Addison, Professor of Hydraulics at Fouad I University, Eiza, Egypt. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., the book retails at $6.50 and contains 656 pages.

Proceedings of Purdue's First Industrial Waste Conference

Although the Second Industrial Waste Conference has been held at Purdue (January of this year) and the proceedings of the First Industrial Waste Utilization Conference, held in November, 1944, have been issued for some time, we understand that Professor Bloodgood, who was Chairman of both conferences, is still receiving requests for Proceedings of the First Conference. More than 3,000 copies of the First Conference have been issued, but there are still a number of copies available for persons who are interested.

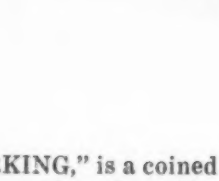
Some one hundred and forty pages are devoted to the printing of the papers which were read at the first meeting in November, 1944, including the topics of Milk Waste, Packing Plant Wastes, Legal Control of Stream Pollution, Utilization and Disposal of Wastes, as well as the wastes from Metal Industries, Whey, Alcohol and Whiskey, Fruit Canning, Petroleum Industry. Also covered are the effects of industrial wastes on sewage treatment, fish life, and stream pollution. The proceedings also include reports of the various symposia or work shops held on different types of wastes.

Persons interested in a copy of these proceedings, or persons desiring a copy of the second proceedings, to be issued later this year, may obtain the same by writing to Professor Don E. Bloodgood, Dept. of Sanitary Engineering, School of Civil Engineering, Purdue University, Lafayette, Ind.

"TELEMARKING"

By C. F. WERTZ
Resident Engineer
DEPT. OF WATER AND SEWERS
MIAMI, FLA.

"TELEMARKING," is a coined word denoting long-distance transmission of information on water levels. The practice is not new, but is not yet being used as generally as its usefulness justifies. For making information readily available on river and lake levels, and on rainfall at remote points, experience with the "Telemark" installed by the Department of Water and Sewers of the City of Miami, Florida, has shown it to be the perfect reporter.



The Author

The operation of a dam in the Miami Canal, used intermittently to control the upstream movement of salt water, and to protect the City's well field from salt water intrusion, is controlled by the water level in the Canal at Pennsuco, a point 14 miles northwest of downtown Miami. The permit from the Everglades Drainage District to construct and operate the dam stipulates, ". . . at no time shall the stage at Pennsuco be raised above 2.2 feet mean sea level datum while the dam is in operation." Also the Department was required to post a bond in the amount of $50,000 to indemnify farmers for any damage caused by the flooding of land which might result from the operation of the dam. Consequently, continual vigilance is necessary during the months that salt water control is required.

During 1943 and 1944, a man was sent from the Water Treatment Plant to Pennsuco (a round-trip of 17 miles) to read the water level gauge. He made one trip a day in fair weather and two trips on rainy days. So important was this matter of water-level maintenance, that if it rained at night the writer would, himself, roll out of bed and drive to Pennsuco, a round-trip of approximately 30 miles. More than one trip has been made in a blinding rainstorm at two o'clock in the morning. After two years we decided to attempt to find some easier method of keeping in touch with the control point.

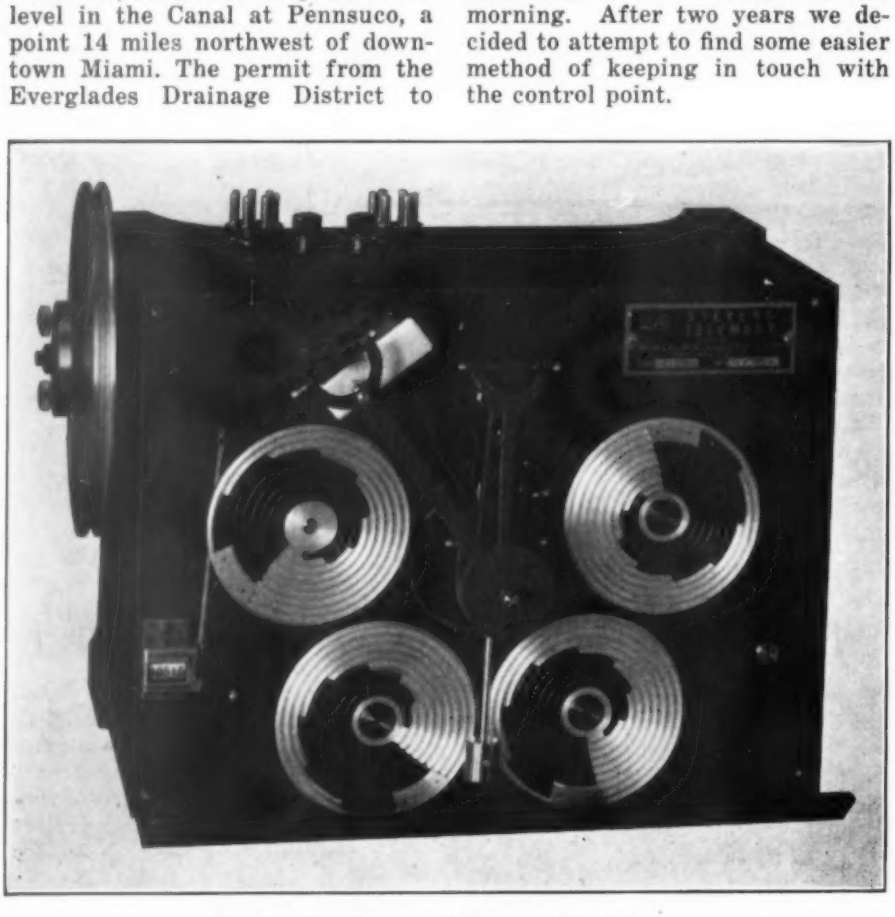


Fig. 1—The Stevens Telemark—Top View.
(Note ridged disks and contact arm.)

The Telemark Is Discovered

Numerous water stage and rainfall recording instruments are maintained throughout the Everglades watershed by the U. S. Geological Survey. A Friez stage recorder was already installed at Pennsuco. Through letters written to instrument manufacturers we finally located what appeared to be the right instrument for our job. It was the Stevens "Telemark," made by Leupold & Stevens Instruments, Portland, Oregon. This instrument is enclosed in a tight metal case, 9¼ in. wide, 12¼ in. long, and 12 in. high. In conjunction with a special relay, called "Unattended Station Relay," developed by the Bell Laboratories of the American Telephone and Telegraph Co., by wire transmittal of dot-and-dash code it will reveal the exact water level at any point that a telephone already exists, or may be installed for receiving the code.

Fig. 1 shows a top view of the Telemark. Fig. 2 shows the Telemark as installed in the temporary shelter which originally housed the Friez stage recorder alone.

Of What the Telemark System Consists

The Telemark consists essentially of two somewhat independent elements: (1) a positioning element, and (2) a signaling element.

The positioning element is actuated by a float resting on the water surface in a stilling well which in Fig. 2 is the wood structure extended well below water. A beaded cable with a counterweight extends from the float to and over the float pulley on the Telemark. A movement of the float pulley positions disks connected by counter gearing and having symmetrically arranged ridges on their upper surfaces—see Fig. 1.

Each disk is divided into ten sectors with each sector containing a different number of ridges. The first sector contains one wide ridge which represents zero. Succeeding sectors contain one to nine narrow ridges.

The center of each disk lies on the arc of a circle, over which the contact arm sweeps while signaling. It is the function of the float to position the proper sector of

each disk on the arc of the circle within the sweep of the contact arm which is ready for signaling the correct position of the water at any time the station is called over the telephone system. The instrument shown in Fig. 1 will signal to the nearest 100th of a foot up to 99.99. Since Everglades water levels never get above 10 feet (mean sea level datum) at the control point, the Miami Telemark has but three disks. These three disks give signals up to 9.99 feet.

The signaling element is a microswitch actuated by the raising and lowering of the contact arm as it revolves and sweeps over the ridges on the disks. A special cam and mercoid arrangement permits contacts to be made only on the approach sector of each disk. The contact arm makes but one complete revolution.

The power source is a sealed 15 volt dry cell battery which has a useful life of about one year or approximately 1,000 calls.

The Unattended Station Relay Box provides a series of relays which operate to close certain circuits when a ringing current is impressed on the telephone line. The ringing generator is automatically disconnected, and certain time delay relays cause a pair of bells to "ding-dong" into the microphone. This "ding-dong" is a substitute for the "hello" of the human voice. After about five seconds the ringing stops, another relay energizes a small motor on the Telemark and this, in turn, starts the contact arm revolving. Signals come as long and short buzzes, which are counted by the listener. - - ——— - - - - - is 2.05 feet. After the signaling stops, the whole mechanism automatically resets itself for the next call.

The equipment is inexpensive. When purchased in November 1944, the Telemark with battery and float cost $340.00 f.o.b. Portland, Oregon. The Southern Bell Telephone and Telegraph Co. ran a wire approximately seven miles on poles already in place, supplied and installed the Unattended Station Relay and a standard wall phone, all for a charge of $25.00 per month.

Facetiously, we call our automatic relay telephone "Bertha." Anyone interested in telemarking may have Bertha's number by communicating with the writer. If, for instance, "Ye Editor" sitting in his office in New York, 1,235 miles away, had the number of the station telephone he could ascertain the height of the water in the Everglades simply by putting in a station-to-station call and listening to the dot and dash code.

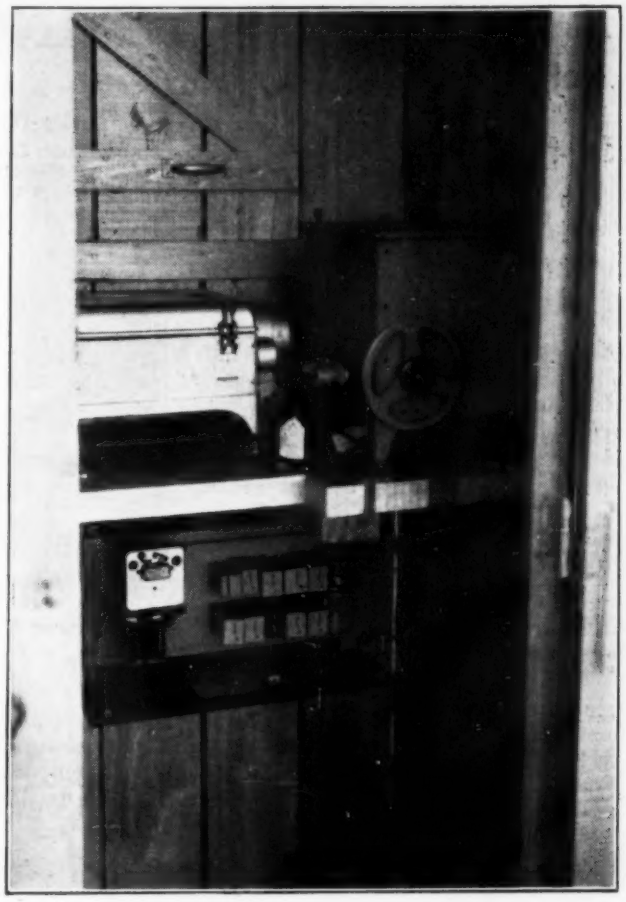


Fig. 2—Telemark Installation.
(Positioning element above; signalling element below.)

Federal Fair Labor Standards Act

From the April *News Letter* of the Penna. Water Works Assn. comes the following comment by John H. Murdoch, Jr., President, on the Federal Fair Labor Standards Act. Many of our readers may find it of interest.

"Many water works executives ask for advice on whether their companies and their employees are covered by the Federal Fair Labor Standards Act of 1938, sometimes called the 'Wages and Hours Law.' Unfortunately, no one can give a quick, sure answer to that question because the Supreme Court has not yet passed on a water works case under the Act. On one side there is the decision of the Missouri Supreme Court in the St. Joseph Water Company case, holding that the water company was a retail establishment, the greater part of whose selling was in Missouri, not interstate, and that the company was not covered by the Act. On the other side we have the rulings of the Administrator of the Act to the effect that many water works employees are engaged in occupations necessary to the production of goods for interstate commerce, and are therefore under the protection of the Act, and that a water company is not a retail estabment such as would be exempt.

"It is not the province of the Association to give legal advice, much less to guess at how these conflicting positions would be treated by the United States Supreme Court. All that we can do is to report that the point is not yet decided. Water works executives must then make their business decisions after weighing the business risks and labor costs involved.

"One thing should be considered which has not been mentioned. It has been the history of all wages and hours legislation that the standards fixed by law tend to become the minimum for all industry, whether covered by the law or not. Whenever most employers in a community accept the standard, then others follow in order to attract and hold desirable employees and to improve public relations. That is a point to consider whenever an inspector for the United States Department of Labor appears in a community and inspects water works records, claiming that the water works is under the Federal Fair Labor Standards Act. Such inspections are being made and executives have a hard problem to solve before taking a firm position."

PROVIDING INCUBATOR SPACE

By H. W. POSTON
Asst. Chief Engr. and Supt.
DEPARTMENT OF WATER
KANSAS CITY, MO.

DURING the past year it became apparent in the Kansas City Water Laboratory that more incubator space was essential. The number of bacteriological samples examined daily had been increased resulting in an over-crowded incubator. Experiments could not be carried out due to lack of space. Furthermore, it was difficult to maintain uniform temperatures with crowded conditions.

After study of the situation it was decided that a new incubator would be purchased. Forced circulation of air within the incubator plus electric heating and multiplicity of doors were the main features we desired to incorporate in the new design. Neat appearance and ease of keeping clean were factors to be considered and given weight in deciding on the ultimate incubator.

Fig. 1. Panel Showing Mounting of Fin Strip Heaters
(Switch for heaters is on reverse side of panel)

A local refrigerator manufacturer was approached with the idea of having an incubator built according to our specifications, the outcome being that a custom built box was out of the question, because of wartime restrictions. Standard refrigerators, however, were available and could be bought minus the compressor unit. A unit of the desired 65 cu. ft. capacity was picked (shown in Fig. 2).

The refrigerator design was adapted to our needs inasmuch as the coils were contained behind a panel. Air in the refrigerator was circulated from the top to the bottom past the coils located back of the panel section.

Stainless steel fin strip heaters

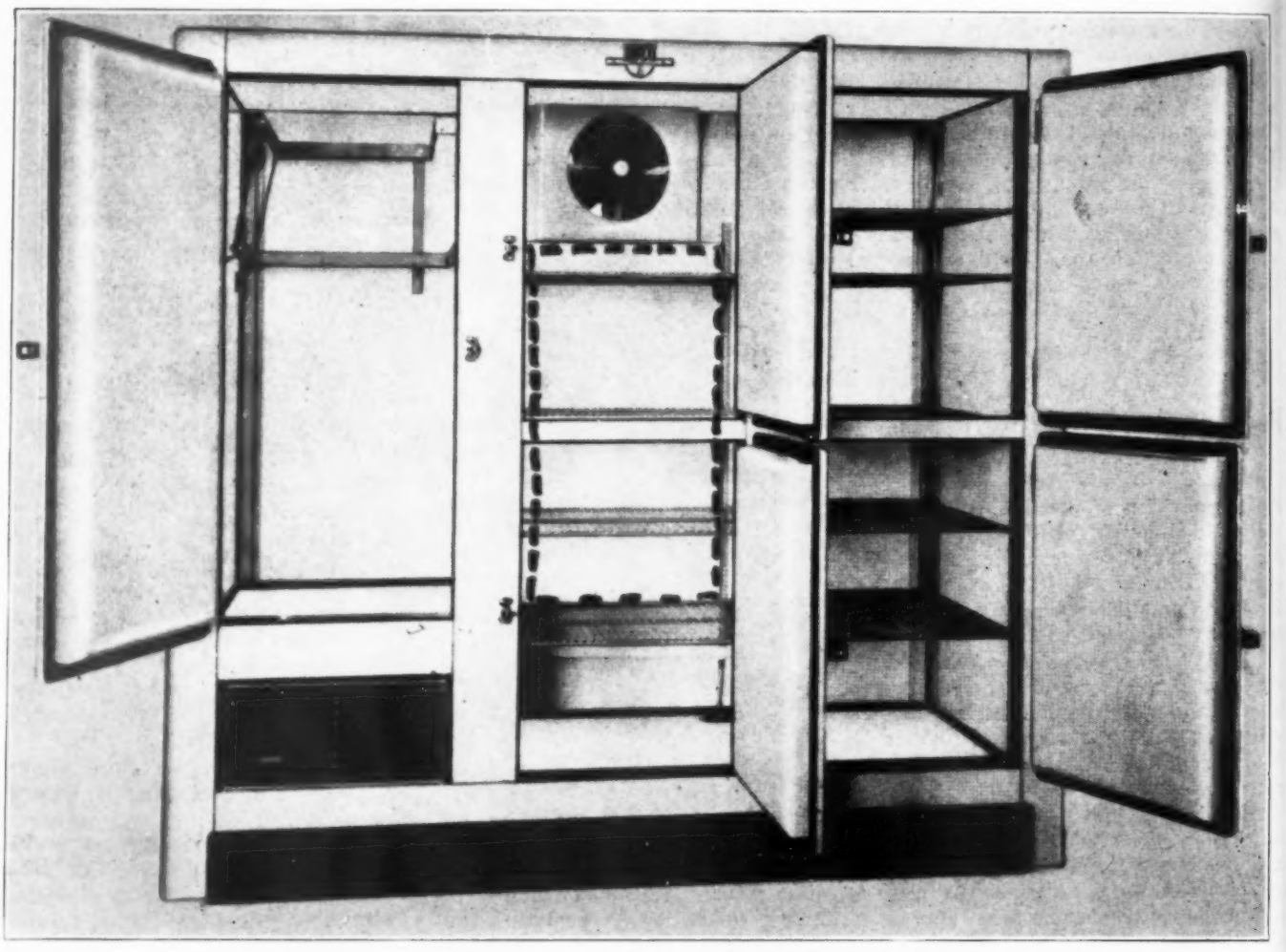


Fig. 2. Standard Refrigerator As Received From Manufacturer
(Heaters were mounted on back of panel enclosed by dotted line.)

were mounted on the back side of the panel with a switch to control each heater (shown in Fig. 1), thus replacing the coils with the heaters. A thermostat and relay were provided as well as a pilot light.

The wiring diagram (Fig. 3) shows the connections as made by our electrician. The total cost was less than $5.00 per cu. ft. capacity.

To date we are pleased with the performance and appearance of the new incubator. Temperature can be maintained within ±1° F. A water container with a piece of porous refractory protruding from the water and into the path of the circulating warm air provides the desired humidity.

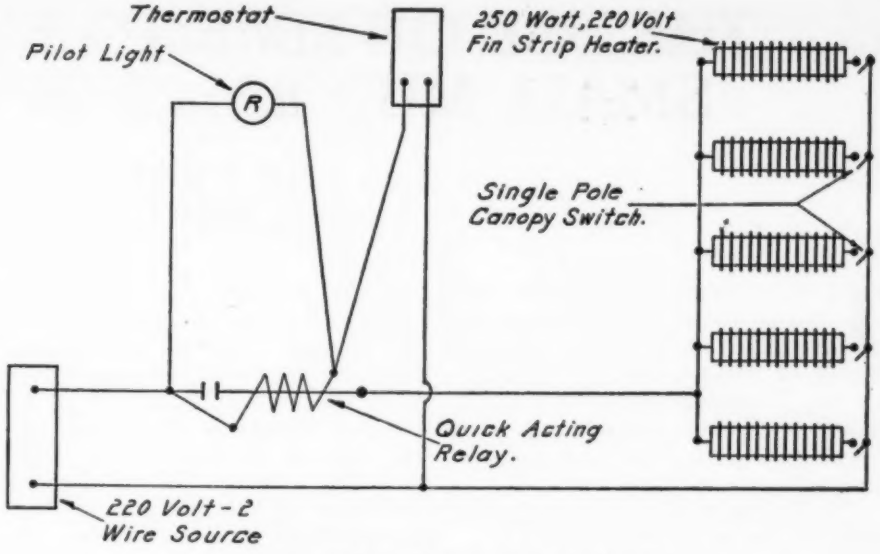


Fig. 3. Wiring Diagram For Incubator

Gladewater Wins Texas Award

The above picture shows Earl Parker, Supt. of Water and Sewerage, turning over the Asa Hunt Cup to Mayor Loyce Phillips of Gladewater, Texas.

Sup't. Parker brought home this token of the state award which was won by Gladewater for having completed the highest ratio of new sewer connections to existing connections of any Texas community during 1945.

The award was announced by Dr. Geo. W. Cox, Director, Department of Health of Texas, during the annual Texas Short School for Water and Sewage Works Operators. The cup, not available at the time, was presented later at a meeting of the East Texas Operators' Ass'n. held in Longview, Tex.

(For the above picture we are indebted to "Bill" Pebworth, Sr., of Dallas.)

Correction, Please!

Someone sent us a picture of water pipe being laid in Singapore just before the fall of the city to the Japs.

This picture appeared in our November 1945 issue and was captioned just as the sender had it labelled—the laying of cast-iron pipe. This proves to be an error, since we now have an objection from Hume Pipe Ltd., of Singapore, who very politely point out that this pipe was not cast-iron pipe but was cement lined welded steel Hume pipe supplied by them.

In all fairness to the eagle eye of one Thomas F. Wolfe, engineer of the Cast-Iron Pipe Ass'n, we must report that shortly after the Singapore picture appeared he wrote us disclaiming the fact that this particular pipe was of cast-iron. However, the pipe pictured has a form of bell end which we couldn't explain, except to assume that it *could be* very light weight cast-iron pipe for low pressures.

[Well—old *W & S Wks.* does get around, doesn't it?—Ed.]

Latin American Sanitary Engineering Progress

San Vicente Sewage System

One of the projects of the Department of Cooperative Inter-American Public Health programs was the sewage system in San Vicente, Chile, which was completed at the end of last year.

San Vicente is a town of 3,200 persons located in the agricultural area of O'Higgins province. The town had a public water supply but no adequate system of sewage disposal. Plans for the system were prepared by the Division of Hydraulics in the Chilean Department of Public Works and the engineering section of the Institute of Inter-American Affairs.

Wm. R. Conard Dies in 76th Year

William R. Conard of Burlington, N. J., long a consulting engineer and recently appointed chairman of the N. J. State Water Commission, passed away at his home on April 30th. He was 76 years old.

Wm. R. Conard

Mr. Conard, during his active years as a specialist and consultant on water supply matters, had served a number of cities and industries. In recognition of his accomplishments in the water supply field he was only last year made an honorary member of the Am. Water Works Association of which he had long been a member and active committee worker. He was also a technical committee chairman in the New England Water Works Assn. for many years and was a member of the Am. Soc. of Civil Engrs.

Mr. Conard was beloved by many and was affectionately known to his friends as "Uncle Billy" Conard. He was a past-commander of the Knights Templar and past-master of the Burlington Lodge of Masons.. Only recently he was made secretary of the Postwar Planning Committee of Burlington.

Mr. Conard was a long standing member of the Union League Club and the Engineers' Club of Philadelphia. He leaves a widow, two sons, two daughters and eleven grandchildren, and a host of friends.

THE USE OF LIME TO ELIMINATE SMALL MUD BALLS IN FILTERS

By A. E. CLARK
Water Supply Engineer
VOLUNTEER ORDNANCE WORKS*
CHATTANOOGA, TENN.

THE following benefits were obtained by the use of lime introduced into the filter influent flumes of the two filtration plants at the Volunteer Ordnance Works located at Tyner, Tennessee.

(1) Elimination of mud blanket on sand surface.

(2) Elimination of small mud balls in the sand bed.

(3) Elimination of turbidity in filtered water when lime was added after filtration.

Source of Supply

Water for the use of the Ordnance Plant is furnished by two filtration plants. Both plants are of the same conventional design, equipped with Flocculators and Monorakes for continuous sludge removal from the settling basins. The filters in each plant are equipped with Wheeler filter bottoms and the usual depths of sand and gravel. The filters are designed for 2 mgd. capacity each. Washing is accomplished by the use of wash water pumps so that at least 50 per cent sand expansion can be obtained. Water is pumped from Chickamauga Lake, which was created by the construction of Chickamauga Dam on the Tennessee River by the T.V.A. Each filter plant is furnished water by one of the two pumping stations located on the shore of the lake approximately one mile apart. The water as pumped from the lake has the characteristics shown in the accompanying table.

Treatment Employed

Treatment of the water consists of prechlorination and ammoniation at the pumping stations, alum for coagulation at the filtration plants and final chlorination in the clear wells. Lime is used for pH control. The original design and construction provided for post treatment with lime or soda ash for pH control. Lime has been used except for a short period of time during 1942 when soda ash was used.

Considerable difficulty was experienced in getting an equal division of lime to each of the two clear wells provided at each plant, which made it difficult for the operators to maintain a constant pH at all times. This resulted in an uneven pH and during the summer months the filtered water contained visible turbidity due to the lime.

No. 2 Filtration Plant was put into service a considerable time after No. 1 and in order to correct the above difficulties changes were made whereby the lime was fed into the influent flume to the filters. Results of both methods of feed could be compared since the lime was fed into the clear wells at No. 1 Plant and in to the influent flume to the filters at No. 2.

Trouble with Mud Balls

Considerable trouble had been experienced at No. 1 Plant by the formation of small mud balls in the filter sand as well as a mud blanket forming on the surface of the sand. Since the filters were not equipped for surface wash, means had to be provided to keep the mud balls at a minimum. It was found that surface washing the filters once each month, manually, using a fantail nozzle 3 in. wide did keep the sand reasonably clear of mud balls. The filters were thoroughly raked before applying the regular wash water and this was followed by hosing the surface of the sand using the fantail nozzle. This operation required the services of two laborers for three days.

It was noted, however, that at No. 2 Filtration Plant there was not any mud blanket on the surface of the sand and only an occasional small mud ball. The filtered water was always free from measureable turbidity using the Baylis Turbidimeter. Based on the condition of the filters at No. 2 Plant, provision was made to feed the lime at No. 1 Plant into the influent flume similar to No. 2 Plant.

Add Lime—Mud Balls Disappear

At the time the change was made at No. 1 the average filter runs for the previous 19 days were 73 hours. Immediately after the lime was added to the influent flume the filter runs started to increase and at the end of the first week had reached 100 hours, the limit allowed at this plant. It was also noted that the mud blanket on the sand was gradually disappearing and when the filters were washed, patches of sand became visible.

On the day lime was introduced into the influent flume at Plant No. 1, one filter was washed, then drained and the sand examined. At one week intervals the same filter has been washed and the sand examined. After one week there was a noticeable decrease in the number of mud balls and at the end of two months there were not any mud balls in the sand. The filter runs are still maintained 100 hours and the filter effluent continues to be free from turbidity.

The quantity of lime used has averaged .045 gpg. and its use has certainly been beneficial.

Monthly Averages of Raw Water (Results in ppm.)

Date	Turbidity	Color	Alkalinity	Chlorides	Hardness	CO_2	Iron	pH
1944								
January	14	37	54	30	77	2.0	0.4	7.7
February	30	45	48	20	60	2.2	0.7	7.4
March	59	40	42	19	48	2.7	1.6	7.3
April	46	40	44	15	51	2.7	0.6	7.4
May	21	43	48	12	50	2.9	0.2	7.5
June	21	37	49	13	51	3.1	0.6	7.4
July	18	32	52	17	54	2.7	0.2	7.4
August	19	27	60	17	59	2.7	0.2	7.7
September	18	21	64	18	58	2.9	0.2	7.5
October	20	26	62	19	58	2.9	0.3	7.5
November	18	25	61	24	66	2.6	0.2	7.4
December	18	23	65	28	75	2.0	0.2	7.7
1945								
January	22	37	59	34	75	2.4	0.2	7.3
February	13	65	59	26	68	2.2	0.4	7.4
March	34	84	56	16	62	2.0	0.4	7.4
April	16	40	61	17	71	2.0	0.3	7.5
May	18	47	51	16	56	2.0	0.5	7.5
June	19	52	48	13	49	3.0	0.2	7.4
July	17	50	52	13	54	4.0	0.3	7.3
August	19	38	55	16	59	4.0	0.4	7.3

Turbidity measurements—Hellige Turbidimeter. Color—Taylor Comparator, pH—Leeds & Northrup Meter.

* Hercules Powder Co., Inc.

SURVEY OF ELEMENTARY MATHEMATICS

For Water and Sewage Works Operators

Part 1

By WARREN K. EGLOF, Ph.D.
Prof. of Chemical Engineering
NIAGARA UNIVERSITY, N. Y.

FRACTIONS

A FRACTION is an expression of unexecuted division. In itself, it is one or more of the equal parts of anything. The *terms* are the numerator and denominator. *Similar* fractions have the same denominator. An *integer* expresses whole units.

Multiplication

To multiply a fraction by an integer, multiply the numerator of the fraction by the integer and place over the same denominator.

$$5 \times \frac{3}{7} = \frac{15}{7}$$

To multiply a fraction by a fraction, multiply the numerators for the new numerator and multiply the denominators for the new denominator.

$$\frac{2}{3} \times \frac{5}{7} = \frac{10}{21}$$

Division

The reciprocal of a number is one (1) divided by that number. To divide an integer by a fraction, multiply the integer by the reciprocal of the fraction.

$$\frac{5}{\frac{2}{10}} = 5 \times \frac{10}{2}$$

To divide a fraction by a fraction, multiply the dividend by the reciprocal of the divisor.

$$\frac{\frac{2}{3}}{\frac{4}{7}} = \frac{2}{3} \times \frac{7}{4} = \frac{14}{12}$$

Addition and Subtraction

The *factors* of a number are all the numbers that multiplied together produce the given number.

$$2 \times 3 \times 5 \times 9 = 270$$

The numbers 2, 3, 5, and 9 are a set of factors of 270. A *multiple* of a number contains that number as a factor. A *common factor* of two or more numbers is a factor of each.

Only similar fractions can be added or subtracted. To add, add the numerators and place over the common denominator.

$$\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$$

Dissimilar fractions must be reduced to similar fractions. This is done by finding the lowest common multiple of the denominators. The denominator of each fraction is divided into the lowest common multiple to get the factor used to reduce the given fraction. The following example illustrates the rule.

$$\frac{2}{3} + \frac{4}{7} + \frac{5}{9}$$

63 is the lowest common multiple —i.e., the lowest number into which all three denominators will go an even number of times.

$$\frac{42}{63} + \frac{36}{63} + \frac{35}{63} = \frac{113}{63}$$

Cancellation

If the numerator and denominator of a fraction are multiplied or divided by the same number, the value of the fraction is not changed. This is the principle of cancellation.

If, however, the same number is *added to* or *subtracted from* both the numerator and denominator of a fraction, the value of the fraction is changed. For example—

$$\frac{3}{4} = \frac{3 \times 2}{4 \times 2} = \frac{6}{8}$$

but $\frac{3}{4}$ is not the same as $\frac{3+2}{4+2}$ which is $\frac{5}{6}$ and not $\frac{6}{8}$ or $\frac{3}{4}$

DECIMALS

When anything is divided into tenths, hundredths, etc., the parts are called decimal divisions. One or more of the decimal divisions of a unit is called a decimal fraction. The denominator of a decimal fraction is not expressed but is indicated by the position of the digits in reference to the decimal point.

$$0.1 = \frac{1}{10} \qquad 0.543 = \frac{543}{1000} \qquad 0.00062 = \frac{62}{100{,}000}$$

The operation of water and sewage works requires no advanced mathematical operations, but the proper use of elementary mathematics will greatly improve the value of laboratory and operating data. For this reason we have asked Dr. Eglof to prepare this series of articles on the fundamentals of elementary mathematics, because we believe they will be of help to all water and sewage works men regardless of their training, education, or experience. This installment represents only one of the series.—The Editors.

Locating the Decimal Point

Annexing zeros to a decimal does not alter its value for calculation. In 0.00624 the two zeros between the point and the six serve to locate the decimal point and have no other meaning.

Common Fractions into Decimals

A common fraction is reduced to a decimal fraction by dividing the numerator by the denominator.

$$\frac{2}{5} = 0.4 \qquad \frac{9}{16} = 0.5625 \qquad \frac{2}{7} = 0.2857 \text{ - - - etc.}$$

Finite and Infinite Decimal Fractions

A finite decimal fraction expresses the value of a common fraction exactly. If the denominator of a common fraction contains no other factors besides 2 or 5, it will give a finite decimal fraction; otherwise, an infinite decimal fraction results, as, for example

$$\frac{1}{7} = 0.142857142857 \text{ - - - etc.}$$

Rounding Off

In practice, infinite decimal fractions must be rounded off. The operator must decide how many decimal places are to be retained. The others are discarded according to the following rules: If the part discarded is greater than five, increase the last place retained by one unit. If the part dropped is less than five, discard without further change. If the part discarded is exactly five, increase the last place retained by one unit.

$$\frac{1}{7} = 0.14285714 \text{ - - - etc.}$$

$$= 0.14$$
$$= 0.143$$
$$= 0.1429$$
$$= 0.14286$$

Converting Decimals to Fractions

To change a decimal fraction to the nearest number of eighths, sixteenths, etc., divide by the decimal equivalent of 1/8 or 1/16. For example—

$$0.34375 = \text{how many } \frac{1}{32}\text{'s}$$

$$\frac{1}{32} = 0.03125 \text{ and } \frac{0.34375}{0.03125} = 11 \text{ or } \frac{11}{32}$$

Placing the Decimal Point

The number of decimal places in a product is the sum of the decimal places in the factors. The number of decimal places in a quotient is equal to those in the dividend minus those in the divisor.

Scientific Notation

$$10^0 = 1$$
$$10^1 = 10$$
$$10^2 = 100 = 10 \times 10$$
$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10$$
$$0.1 = 10^{-1}$$
$$0.01 = 10^{-2}$$
$$0.0001 = 10^{-4}$$
$$0.00473 = \frac{473}{100{,}000} = \frac{47.3}{10{,}000} = \frac{4.73}{1000} = 4.73 \times 10^{-3}$$

Any number may be expressed as a number between 1 and 10 multiplied by some power of 10.

$$22{,}000{,}000 = 9.2 \times 10^7$$
$$349.2 = 3.492 \times 10^2$$
$$0.00498 = 4.98 \times 10^{-3}$$

The power of 10 used is equal to the number of places that the decimal point has been shifted; positive if moved to the left and negative if moved to the right. Numbers in the scientific notation may be added or subtracted only when the powers of 10 are equal for both.

$$3.72\times10^3+8.56\times10^3 = (3.72+8.56)\,10^3 = 12.28\times10^3 \text{ or } 1.228\times10^4$$
$$4.53\times10^3+1.271\times10^4 = 4.53\times10^3+12.71\times10^3 = 17.24\times10^3 = 1.724\times10^4$$

Numbers in the scientific notation can be divided or multiplied.

$$\frac{10^m}{10^n} = 10^{m-n}$$
$$\frac{6\times10^4}{2\times10^2} = \frac{6}{2}\times\frac{10^4}{10^2} = 3\times10^{4-2} = 3\times10^2$$
$$10^m\times10^n = 10^{m+n}$$
$$(2\times10^3)\times(3\times10^3) = 2\times3\times10^3\times10^3 = 2\times3\times10^{3+3} = 6\times10^6$$

In division the main numbers are divided, while the power factors are subtracted. In multiplication the main numbers are multiplied, while the power factors are added.

PERCENTAGE

Per cent literally means "by the hundred," or parts per 100 parts. Per cent is the numerator of a fraction whose denominator is always 100.

$$\frac{50}{100} = 50\% \qquad \frac{2.5}{100} = 2.5\%, \text{ etc.}$$

Common fraction, decimal fraction, and per cent are related terms. When using per cent, it is very important to recognize the *base*. If we have 8 grams of a material that contains 3 grams of sand, the ratio of the weight of the sand to the weight of the whole sample is 3 to 8. Here the base is the weight of the entire sample.

$$\frac{3}{8} = 0.375 = \frac{0.375}{1} = \frac{37.5}{100} = 37.5\%$$

Per cent	Common fraction	Decimal fraction
1	$\frac{1}{100}$	0.01
14	$\frac{14}{100}$	0.14
360	$\frac{360}{100}$	3.60
0.002	$\frac{2}{100{,}000}$	0.00002
0.0001	$\frac{1}{1{,}000{,}000}$	0.000001

Problems in Percentage

Problem: What weight of water is in a ton of sludge that is 60 per cent water? Sixty per cent means that 60/100 of any weight of sludge is water.

$$2000 \times \frac{60}{100} = 2000 \times 0.6 = 1200 \text{ lb.} \quad \text{Ans.}$$

Problem: The chlorine demand of a liquid is 9 ppm. After chlorination, the demand was 2 ppm. What is the per cent satisfaction of the demand?

$$9 - 2 = \text{part of demand satisfied.}$$
$$\frac{9-2}{9} = \frac{7}{9} = 0.77$$
$$0.77 \times 100 = 77\% \text{ satisfaction}$$

Problem: What weight of water and alum are needed to make 5000 lb. of a 5 per cent solution?

$$5000 \times \frac{5}{100} = 250 \text{ lb. of alum}$$
$$5000 - 250 = 4750 \text{ lb. of water}$$
$$5000 \text{ lb. total}$$

Observe that a 5 per cent solution means 5 lb. of alum in 100 lb. of solution. Both the alum and the solution are expressed in the same units. This is, in general, the case when per cent (%) is being considered.

To arrive at the gallons of water required to make up the 5 per cent solution, it is necessary to divide pounds of water by the factor 8.34, which is pounds of water in each gallon.

$$\frac{4750}{8.34} = 570 \text{ gals. for all practical purpose}$$

Problem: If 3.75 lb. of H.T.H. containing 70 per cent available chlorine is dissolved in 30 gallons of water, what is the per cent (%) available chlorine in the solution?

$$3.75 \times 0.70 = \text{lbs. available chlorine} = 0.263 \text{ lbs.}$$
$$\frac{3.75\times0.70}{30\times8.34} = \frac{0.263}{250} = \text{lbs. available chlorine in 1 lb. of solu.} = .0105$$
$$100 \times 0.0105 = 1.05\%$$

Problem: Suspended solids in the influent is 600 ppm. and in the effluent 400 ppm. What is the per cent efficiency of removal?

$$600 - 400 = 200 \text{ removed}$$
$$\frac{200}{600} = 0.333$$
$$0.333 \times 100 = 33.3\%$$

PROPORTION

The indicated division of two pure numbers is a ratio. The ratio of 3 to 4 is usually expressed as 3:4 or sometimes as 3/4. A proportion is an equality of two ratios and is written in the form a:b = c:d or a/b = c/d and is expressed as "a" is to "b," as "c" is to "d." "A" and "d" are the *extremes*, while "b" and "c" are the *means*. The product of the extremes in a true proportion must always equal the product of the means.

Therefore, from the proportion—

$$a : b = c : d$$

we get

$$a \times d = c \times b$$

(extremes) (means)

To find any one of the values when the other three are known, by transposing values from one side to the other, the equation becomes any one of the following.

(1) $$a = \frac{c \times b}{d}$$

(2) $$d = \frac{c \times b}{a}$$

(3) $$\frac{a \times d}{c} = b$$

(4) $$\frac{a \times d}{b} = c$$

The rule to remember is that in transferring the known value in the extremes or the means from one side of the equation to the other, when solving for the unknown value, it is necessary to divide the product of the means or extremes (as the case may be) by the value transferred.

Direct and Inverse Proportion

Two varying quantities are *directly proportional* if the ratio of corresponding values is constant.

Problem: If 3.75 lb. of H.T.H. is added to 30 gallons of water to make a solution of given strength, how many pounds will have to be added to 147 gallons to make a solution of the same concentration?

$$3.75:30 = x:147$$

multiplying the extremes and the means gives

$$3.75 \times 147 = 30 \times x$$

and solving for x, the unknown portion, we have

$$\frac{3.75 \times 147}{30} = x = 18.37 \text{ lb.}$$

Two varying quantities are *inversely proportional* if their product is constant.

Problem: A gas holder contains 10,000 cubic feet of gas at a pressure of 3 pounds per square inch. If the volume is compressed to 3,000 cubic feet, what is the new pressure?

$$10{,}000 \times 3 = 3000 \times P$$
$$\frac{30{,}000}{3000} = 10 \text{ lb. per sq. in.}$$

Partitive Proportion

Partitive proportion divides a quantity into two or more parts that have specified ratios to each other.

Problem: Divide 27 into two parts that are in the ratio of 2:7.

$$2 + 7 = 9$$

$$27 \times \frac{2}{9} = 6 \quad \text{Ans.}$$

$$27 \times \frac{7}{9} = 21 \quad \text{Ans.}$$

Problem: Divide 81 into four parts that are in the ratios of 2:4:3:7.

$$2 + 4 + 3 + 7 = 16$$

$$\frac{2}{16} \times 81 = 10.12$$

$$\frac{4}{16} \times 81 = 20.25$$

$$\frac{3}{16} \times 81 = 15.20$$

$$\frac{7}{16} \times 81 = 35.44$$

Partitive proportion is useful in distributing a quantity among several others in proportion to the value of the latter.

SIGNIFICANT FIGURES

Two kinds of numbers are used in practical calculations. These are *absolutes and measurements.* An "absolute" expresses the value of something exactly. "Measurements" are the readings of scales, balances, meters, gages, and manometers. Every device for measuring has a threshold or sensitivity limit below which a change in the thing measured will not be detectable. *Every number representing a measurement is thus inexact or incomplete.*

If a meter shows a velocity of 3.21 ft./sec., we must recognize that it is really 3.21xyz and that all values for the decimal places beyond the second are real but unknown, using that particular meter. When measurements are combined by arithmetical operations, care is needed to avoid results that are absurd, meaningless, or actually fictitious.

A digit is one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. The number 3427.67 means

$$3\,(1000) + 4\,(100) + 2\,(10) + 7\,(1) + 6\,(1/10) + 7\,(1/100)$$

The numbers within the parentheses are the unities in terms of which any number is expressed. The numbers before the parentheses are the significant figures. The number 2 is in the "tens" place, for example.

Determining Significant Numbers

A *significant* figure in a number expresses the number of *units* in the *place* in which it is located. The decimal point has nothing to do with significant figures. Zero may or may not be significant. In 0.006507, the zeros before the 6 are not significant, but the zero between 5 and 7 is significant.

The number of significant figures in a measurement is determined by the instrument and the conditions under which it is used. If the instrument is properly made, in good adjustment, and used by a trained observer, its readings will be correct *"as far as they go."* What does "as far as they go" mean? If we have a balance that will not indicate differences in mass of less than 0.1 gram, then any object weighed on this balance will be unknown beyond the first decimal place. If an object weighs somewhere between 12.8 and 12.9 and is recorded as 12.85, the weight of the object is really some absolute number between 12.8 and 12.9—i.e., plus or minus the 12.85.

Maximum and Relative Errors

The 12.85 is a rounded-off value. It may be in error by 0.05 either way. We do not know the exact value but we do know that the *maximum error* is not greater than 0.05. The *maximum relative error* is the maximum possible error divided by the measurement and multiplied by 100 —in other words, expressed in per cent. In calculating the maximum relative error, only two significant figures are used in the measurement —the observed value and the maximum possible error. In this instance—

$$\frac{0.05}{12.85} \text{ is written } \frac{0.05}{13.00} \times 100 = 0.38\%$$

This is to say, the above weighing cannot be "trusted" to better than 0.38 per cent of true weight. The number of significant figures in a measurement gives some idea as to how far it can be trusted. When measurements are arithmetically combined, the errors in each of them go into the answer. The answer may become grossly misleading even if all operations in the pure arithmetic are strictly correct.

Significant Figures and Rounding Off

Unfortunately, as numbers are usually written, zero may have two meanings. It is used as a significant figure and also to locate the decimal point. In 22,400 as a measurement, we are not sure which meaning is to be given to the zeros. It would be better to write it as 2.24×10^4. This clearly indicates only three significant figures.

Problem: The following measurements are to be added: 22,400, 3642.2 and 23.24. The zeros in 22,400 are not significant.

$$\begin{array}{r} 224\text{xym.n} \\ 3642.2\text{k} \\ 23.24 \\ \hline \end{array}$$

Observe that xymnk are unknown.

Observe that the 4th vertical column containing x, 4, 2 is the first column, containing an unknown, that the eye reaches as it moves towards the right. All columns to the right of this x, 4, 2 column are to be discarded following the rules for rounding off. We now have

$$\begin{array}{r} 224\text{x-.} \\ 364\text{-.} \\ 22\text{-.} \\ \hline 2606\text{-.} \end{array} \qquad \text{Assume } x = 0 \text{ temporarily}$$

This is now rounded back to 261--. or 26,100, with the last two zeros not significant.

Problem: Add 22.4, 3.675 and 0.8742.

$$\begin{array}{r} 22.4\text{---} \\ 3.675\text{-} \\ 0.872 \\ \hline \end{array} \qquad \text{round off and rewrite} \qquad \begin{array}{r} 22.4\text{-} \\ 3.68 \\ 0.88 \\ \hline 26.96 \end{array}$$

Since the second decimal place must be dropped, the answer is 27.0.

Problem: Multiply the following measurements together:

$$34.72 \times 359.74 \times 0.0016$$

If we multiply as in pure arithmetic, we get 19.98267648. The operator vaguely recognizes that all the decimal places obtained are not necessary and proceeds probably to record the result as 19.98, but without knowing why he kept two decimal places instead of one or three. Better procedure would be as follows: Note the factor with the smallest number of significant figures. This is 0.0016 with only two significant figures. Round off the other factors so that they have only one more significant figure. We now have

$$34.7 \times 360 \times 0.0016$$

$34.7 \times 360 = 12492$ rounded off to 12,500

$12500 \times 0.0016 = 20.0000$ rounded off to 20 (125×16)

The answer in general must have no more significant figures than the factor with the smallest number of significant figures.

Rules Governing Calculation of Errors

The following rules govern all cases:

Maximum error of a sum = sum of maximum errors of measurements added.

Maximum error of a difference = sum of maximum errors of measurements subtracted.

% error of product = sum of % errors of factors.

% errors of quotient = sum of % errors of factors.

Problem: Divide 2.047 by 1.24. Calculate the % maximum relative error in the answer.

$$\frac{2.04}{1.24} = 1.65$$

Max. rel. error in 2.047 = 0.025%
Max. rel. error in 1.24 = 0.42%
Max. rel. error in answer = 0.44%

(*To be continued*)

NEW JERSEY SECTION HEARS EXPERTS ON METERING*

131 Attend Winter Meeting at New Brunswick

WELCOMING back a number of men from military service, the New Jersey Section of AWWA held its Winter Meeting in New Brunswick and heard a strong case for the conservation of water by metering. Presided over by Wm. E. Collings, Chairman, the 131 persons in attendance also adopted a resolution stating that the section objects to the construction of the New Jersey Ship Canal *unless* it can definitely be demonstrated that *no* damage to water supplies will occur.

Following the principal speaker, a panel of experts headed by Samuel Newkirk, Jr., past pres. of AWWA, discussed meters and problems of metering.

Water Conservation by Metering

Prof. Thurlon C. Nelson, Ph.D., D.Sc., Chairman of the N. J. Water Policy Commission, and Prof. of Zoology of Rutgers University, presented a strong case for "Water Conservation in New Jersey and The Role of Metering Therein."

Pointing out that water works planners must have vision based on knowledge not only of plant design but also on knowledge of growth curves, population trends, industrial progress, and markets, such vision must include the effect of hydrologic conditions, and the relation between available water supply and demand.

In New Jersey where the demand is critically close to the supply, water conservation appears imperative, especially in view of the predicted drouth of 1954-56.

That metering can and does play an important part in water conservation is evident from these figures prepared in 1923 by **H. T. Critchlow**, Chief Engineer of the State Water Policy Commission:

No. of Water Systems	Per Cent Metered	Population Served Thousands	Per Capita Consumption gpd.
34.....	0-10	262	155
36.....	10-90	1,077	119
37.....	90-100	1,530	96

Dr. Nelson cited the following figures as further evidence of the conservation of water by metering.

Community	Before Metering		After Metering	
	% Metered	Per Cap. Consumption gpd.	% Metered	Per Cap. Consumption gpd.
Ridgefield ..	2	72	100	62
Moorestown	9	90	100	59
Swedesboro	10	100	96	55
Woodbury ..	2	150	99	63
Jersey City	24	159	100	123

It is the policy of the N. J. Water Policy Committee not to permit further diversion of water to unmetered cities. With the Inter-connection program and metering it is believed that more persons can be served with the water now available.

PANEL DISCUSSION— QUESTIONS AND ANSWERS

Under the leadership of **S. F. Newkirk,** Engineer and Supt. of Elizabeth, five members participated in a panel discussion on Water Meters and Conservation. These experts were E. Shaw Cole (Pitometer Co.); J. H. Faulks (Neptune Meter Co.), Dave Purdie (Builders-Providence) and W. C. Flanders (Worthington-Gamon Meter Co.). Not only was the general question of Meters and Water Conservation discussed, but several other questions on meters were presented to the board. In the following report the answers are briefed under the various headings.

Water Meters and Conservation

Faulks: Meters not only reduce water consumption but sewage flow as well.

Cole: The pitometer will reveal the amount of under ground leakage. Where unaccounted for water is over 20 per cent a pitometer survey will show means of making savings. While water meters cut consumer waste, pitometer surveys often will indicate that meters are not registering correctly.

Flanders: The per cent of water conservation effected by meters will depend on the type of city and the industry involved. For example in Chicago, 10 per cent of the meters bring in 40 per cent of the metered revenue.

Ford: The cost of meter maintenance to the consumer is important. Meters can be pulled out too often for repair. The question is, how fast does a meter run down hill.

Purdie: Venturi meters are used to measure the amount of raw water or the water delivered to the system. Without knowledge of that volume, no one can estimate how much water is lost or wasted by lack of meters.

How to Acquire Private Meters When Universal Metering Is Adopted

Flanders: Purchase the meters or have consumers deed meters over to the city.

Faulks: One city condemned the private meters as they went bad.

Ford: In general, good practice favors the city owning the meter. The meter is the cash register of the business and therefore should be owned by the purveyors.

Plan of Installation on Universal Metering

Faulks: Suggest contracting for installation by plumbers, or increasing personnel to do the job.

Cole: Use selective installation of meters by districts where pitometer shows the night rate (i.e. waste) is highest.

Flanders: Suggest dividing the pipe cutting among plumbers.

Purdie: Install the most meters in the areas where they will bring in the most money—or install meters in the oldest residences where plumbing leaks are most prevalent.

How Does One Determine Proper Meter Size

Roswell P. Roper of East Orange raised the question as to how to determine the proper size of meters and asked if the average per capita consumption were known for different pressures.

Master Meters give different results depending on type of family flushometers, pressure, etc. Although certain values have been developed* for different types of houses and fixtures, there are no adequate data on the subject of pressure effects on these values. (G.E.S.)

*This report was prepared for publication in the April issue, but space limitations did not permit its use. We are therefore publishing it now with our apologies to the N. J. Sect.

*See *Water Works & Sewerage*, Vol. 93, June, 1945, Reference and Data Section, pp. R-117, R-19, and R-111.

PRESENT TRENDS IN THE SEWAGE WORKS FIELD*

By W. H. WISELY
Executive Secretary-Editor
FEDERATION OF SEWAGE WORKS ASSNS.
CHAMPAIGN, ILL.

DURING a period of great activity in any endeavor, it is always worth while to pause occasionally for a perspective view. The sewage works field is about to engage in an era of activity which may be the greatest in its history, as evidenced by the fact that upwards of one and a quarter billion dollars of construction is in or through the planning stage at this time. It is my purpose to review objectively the trends of the times as we embark upon this huge undertaking.

The Author

In no field of endeavor is a constant course maintained although stabilization of action obtains as experience accrues. The sewage works field of today is sufficiently young to be undergoing changes of direction in many respects; several prewar trends, however, appear to be soundly founded and will continue at least for the immediate future. Trends may be strong or weak, good or bad, and some of them may be interdependent. A change in trend is usually the result of an outside force as, for example, the war just ended. It is the writer's opinion that the war has given opportunity to take inventory of the results of the flurry of construction which took place from 1932 to 1940 and that many of the mistakes of the "boom of the 30's" will not be repeated. Our course at present is substantially sound but there is need for correction and additional emphasis in regard to several factors.

Administrative Trends

The war has brought about a much greater comprehension, on the part of military personnel and the public, of the importance of sewer systems and sewage treatment facilities. There was little prewar concern with stream pollution problems in a number of states but a stimulation of interest has taken place by virtue of the construction of the many plants serving military installations. Evidence of this new consciousness is the activity of several states, including Tennessee, Louisiana, North Carolina, Colorado, Virginia, Maryland and others, toward the development and strengthening of pollution control legislation. Further proof is in the interest of Congress in national pollution control legislation, there being no less than three pairs of companion bills under consideration in the current session. The day does not appear to be too distant when every state will have the necessary legislation establishing authority to control effectively the pollution of streams within its boundaries.

There has been interest for some years in the training and licensing of sewage works operators but relatively few states have shown real progress. Within the past few months, existing operators' certification plans in Michigan and Texas were strengthened by new legislation, and Indiana, although unsuccessful in its efforts this year, has made progress toward this objective. It is hoped that these activities represent a trend and that pollution control officials in every state will not rest until suitable certification or licensing programs provide for the recognition and protection of competent personnel. There is also a general appreciation of the impending demand for experienced operators and there are indications that training schools and short courses will be conducted on a larger scale and in more elaborate fashion than in the past.

The war has brought generally higher compensation levels to all occupations and the resulting competition with industry has brought somewhat higher remuneration to sewage works operation personnel —a most welcome development. Of further benefit in this connection, perhaps, was the favorable scale of salaries developed by the R. & U. Section of the Corps of Engineers for application to operating staffs in military sewage works. Let us hope that this, too, represents a trend.

During the past two years, many municipalities have been studying deficiencies in sewage works facilities and have had time to appreciate the many benefits of regional solutions where one or more municipalities might join together in a common answer to the sewage collection and treatment problems. There is a marked revival of interest in sanitary districts and in the solution of pollution problems on a watershed basis. This trend is indeed a healthy one and will find substantial support in the fine records of sanitary districts which have been operating in the Midwest for more than twenty years. In England, many small and obsolete sewage treatment plants are now being replaced by larger works serving groups of separate municipalities, indicating that this trend is not restricted to the U. S.

Trends in Sewage Treatment Practice

Wartime experience has yielded valuable knowledge of the evaluation of conventional sewage treatment methods as subjected to wide and abrupt variations in load. Much knowledge has also been gained in connection with the treatment of sewage high in grease and laundry waste content. It is hardly possible to foretell the processes which will come from this experience with the most popularity. Such conjecture is not of great importance after all, but it is hoped that the knowledge gained from wartime experience will be reflected in a more careful selection of the types and capacities of the processes which best fit the needs of each individual problem.

The emergency construction of supplementary units for the relief of overloaded plants during the war has resulted in many heretofore uncommon combinations of treatment processes. Several of these combinations have shown to considerable advantage and it is not unlikely that new treatment works handling

*Presented before the North Carolina Water and Sewage Works Conference.

Package Style Activated Sludge Plants.
Constituting a trend in the solution of sewage treatment problems of small communities and institutions, more than a hundred of these "watch-fob" plants are now in successful use.

strong mixtures of industrial wastes and sewage will incorporate unusual combinations of treatment devices.

There is little evidence of anything really new in the way of fundamental processes of sewage treatment. It is obvious that the trend here is a continuation of the high pressuring of known and tried fundamental methods, which movement has been in progress for several years. High rate filters continue to receive wide attention; several new modifications of the activated sludge process promise accelerated rates of treatment and reduced susceptibility to shock loads; the attention being accorded the separate treatment of digester supernatant liquor indicates a trend toward heavier loading of digesters with subsequent special treatment of overflow liquors before return to other treatment units—these are typical.

Another trend of recent years which may be expected to continue is that toward the greater use of mechanical equipment. Few phases of the art of sewage treatment have progressed at so rapid a rate in recent years as has the design and manufacture of mechanical equipment intended to eliminate and minimize the many disagreeable tasks in sewage works operation which were formerly performed manually.

During the war, equipment manufacturers have been busily engaged in the observation of existing installations of their products and in the conduct of research to be applied in the development of improvements. Simpler and more efficient machinery, durably built to withstand hard service, will be the outcome. Particular interest is being manifested at this time by manufacturers of metering and control equipment and we may anticipate marked improvement in these lines.

This field is indeed fortunate to be served by a group of equipment producers which is so alert to the design, construction, and operation problems which are encountered and so ready to adapt their products to practical needs. A large percentage of plant shutdowns and partial outages in the past have been caused by mechanical breakdowns, often resulting in serious interference with biological processes; the anticipated advances in equipment design and construction should materially reduce such interruptions in service.

There is every reason to believe that the by-products of sewage treatment will be utilized to an increasingly greater extent. The conversion of digester gas into power was gaining rapidly in popularity before the war; the recent development of improved dual fuel engines will undoubtedly accelerate this trend. The future will see digester gas engine installations made in smaller treatment works than were previously believed economically adapted to gas utilization for power.

The technical interest and progress being made in heat drying of sewage sludge should bring about greater use of this by-product for soil conditioning purposes. Manual of Practice No. 2 of the Federation, entitled "Utilization of Sewage Sludge for Fertilizer" and now in preparation, should be a factor in this trend. This nation is becoming increasingly conscious of soil conservation and it is not likely that the economic waste of the soil improvement values of sewage sludge will continue to be overlooked.

Sewage works operators may find solace in the indication that many new troublesome maintenance problems will be minimized or eliminated. Mention has already been made of the sturdier and more durable mechanical equipment which is to be expected. Some corrosion resistant metals and alloys, such as aluminum and stainless steel, have been made cheaper during the war by virtue of increased production capacity and improved methods of production, and such metals should find much wider application in sewage works than has heretofore been possible because of cost considerations. New plastics and protective coatings, developed and restricted to wartime purposes, should find application in sewage works, to the end that many maintenance problems become simplified. These developments at least merit our interest.

Trend in Dual Disposal of Garbage and Sewage

The number of sewage treatment works in which garbage is being handled for treatment and disposal is relatively small at this time. Judging by inquiries received at Federation headquarters, however, there is some current interest in the installation of new facilities designed to handle both wastes. Information at this time is inadequate on the economics of garbage collection with rubbish as compared to discharge to public sewers but there are many cases, no doubt, in which municipalities are experiencing difficulty with garbage disposal and will seek a solution through the provision of adequate sewage treatment works.

In the most successful dual disposal installations today, the garbage is not added to the sewage flow but is discharged in a shredded state to the sewage sludge for combined digestion, dewatering and disposal. It has been demonstrated that dual disposal can be accomplished satisfactorily provided that adequate digestion and sludge dewatering capacity is available and if careful attention is accorded the

details of the design of garbage handling facilities.

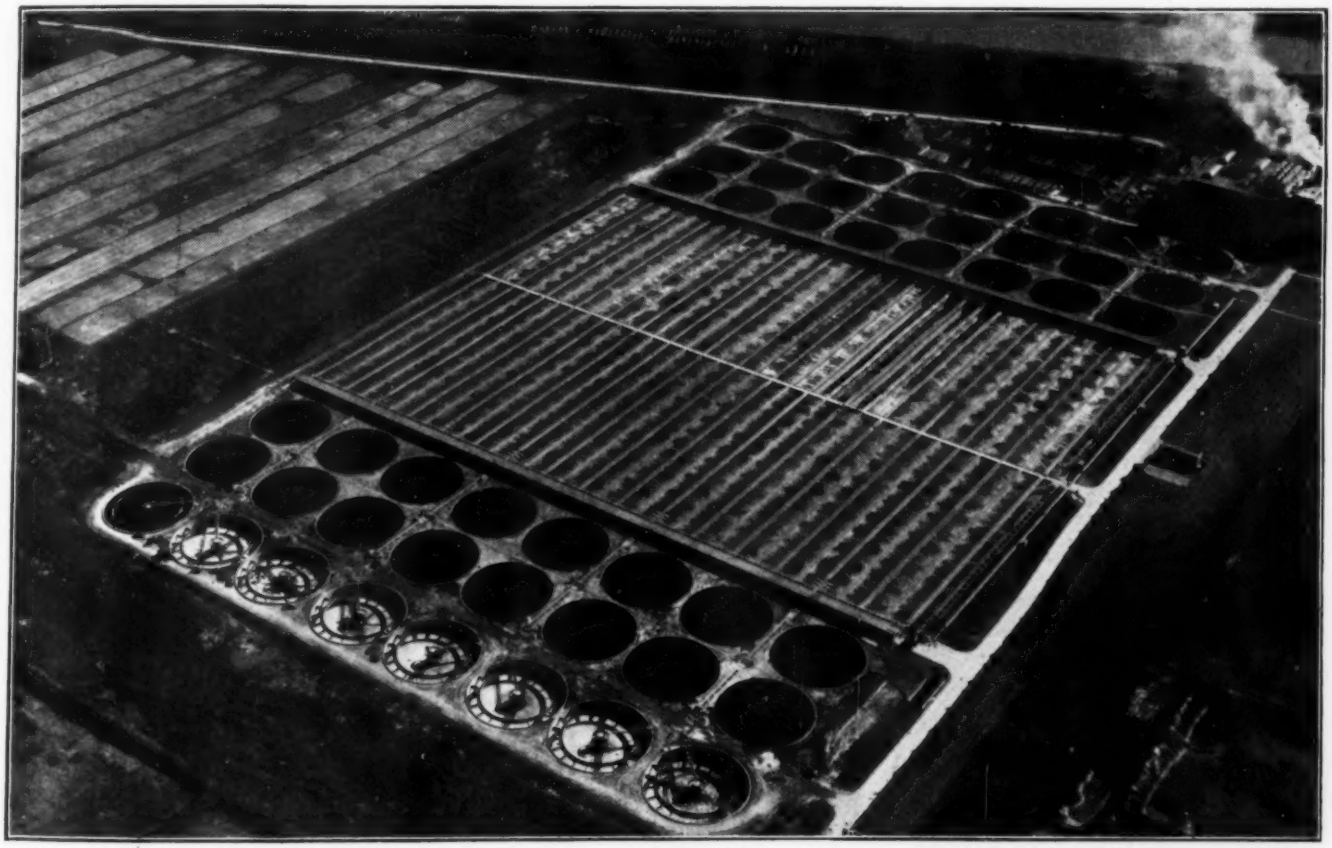
Home garbage grinding is a trend which, in the opinion of the writer, justifies attention. It is believed that the home grinder will find extensive use in the U. S. in the next 10 years because of its obvious appeal to the housewife and its apparent public health advantages. There are many, however, who feel that the use of home grinders will be restricted by cost and other considerations.

G. J. Schroepfer, in a report to the Board of Trustees of the Minneapolis-St. Paul Sanitary District, estimates that the cost of sewage treatment in the Minneapolis-St. Paul plant could be increased approximately 55c annually per home grinder installation and refers to a possibility that as much as one-third of the garbage in the Twin Cities might be reaching the public sewers by way of such grinders in the next 10 years. Certainly, the extent to which home grinding is accepted will vary according to the type of communities but it is believed not unreasonable to expect that 20 per cent of the homes in high class residential communities might be served by home grinders in the next decade. Such a quantity of garbage would represent only 4 or 5 per cent increase in organic load at the treatment works but more important, perhaps, are the characteristics of the material. Some readjustment of dilution ratios at storm overflows of combined sewer systems may be required; grit, scum and sludge handling facilities would receive an added burden and sludge conditioning and dewatering requirements may require some revision. Home garbage grinding is certainly a trend; its ultimate influence must be watched carefully although not with alarm.

Industrial Waste Treatment Trends

Industrial waste problems are receiving a very great deal of attention by researchers today. The Federation's Research Committee, in its survey published in July, 1945, issue of *Sewage Works Journal*, reports that 46 industrial waste studies were included in a total of 82 research projects underway in 1945. Wastes from paper manufacture, food processing, canning, leather tanning, textile processing, metal processing and oil production and refining are receiving major attention. Industry itself is conducting much of the current research through such agencies as the National Council for Stream Improvement (of the Paper, Pulp and Paperboard Industry), the National Canners' Assn., the American Iron and Steel Institute, the Petroleum Institute, the Textile Foundation and others. If these agencies attack their problems with the same zeal and ingenuity that has characterized industrial progress during the war, notable accomplishments in by-products recovery and waste disposal practice may be anticipated.

In the past, lack of complete understanding between industry and stream pollution control authorities has been something of a deterrent to the abatement of industrial pollution in general. There are encouraging indications of a mutual willingness to respect conflicting points of view and to cooperate in achieving practical solutions to industrial waste disposal problems. There has been similar procrastination in the division of responsibility between industry and municipal officials, where industrial wastes are discharged to public sewers



Enlargement and Improvement—A Trend in Large Communities.
The world's largest sewage treatment plant typifies the enlargement trend by the addition of settling tanks (foreground) with new design ring effluent launders well out from side walls. Several of the aeration units are equipped with various types of diffusers in a program of large scale experimentation.

without regard for the limitations of sewage treatment facilities. The logical and economical procedure in many cases involves the pretreatment of industrial wastes with provisions in the way of extra capacity and special facilities at the municipal plant to handle such pretreated wastes and with industry bearing its share of the cost of treatment. Pollution control authorities will be called upon to bear the burden of arbitration in many of these instances and must earn the full confidence of all parties concerned if they are to expect success.

Industrial waste pollution is probably the most pressing of all problems confronting the field today; we are only at the threshold of its solution.

Conclusion

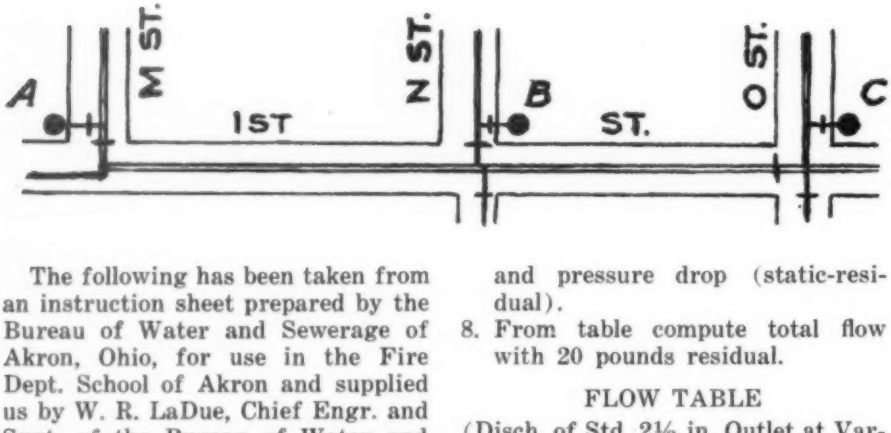
Two important trends—one of long standing, the other relatively new—have been withheld to this point because they are unfavorable and thus deserve particular emphasis.

The source of a great many vexing problems of sewage disposal is the old and continuing laxity in regard to the control of the usage of public sewers. It is high time that we undertook a redefinition of the word "sewage"—not so much as to state what it comprises but so as to define what it does *not* include. It will take much more than a new definition, of course, to bring about the complete exclusion of excess storm water, inflammable and explosive substances, solids and congealing materials that cause clogging, corrosive wastes and toxic substances that interfere with biological processes of sewage treatment. The solution entails a new respect for the basic sewer ordinance with firmness in enforcement. This is a matter to which immediate and conscientious administrative attention could be directed with great advantage.

The second and newer unfavorable trend referred to above is the false significance of speed as a factor of importance in design and construction operations. The deadline plague first reared its ugly head during the P.W.A. program of the depression, when adherence to a time schedule, instead of sound planning and good workmanship, was considered the essence of success. During the war, design and construction was hurried at such a dizzy pace as to outdistance even the fastest P.W.A. projects, but for good reason. In consequence, practices were tolerated and standards lowered to an extent not excusable in time of peace, and an abrupt realignment of values is very much in order. Sewage works are built for the future; a few weeks or months are certainly insignificant when public service 20 to 60 years hence is in the balance. It is time to restore individualistic design, fitted to local requirements, and the kind of workmanship that yields only to obsolescence, as the first criteria of a good job.

The task before us offers a stirring challenge. Let us not miss the opportunity to do it justice.

FIRE FLOW TESTS ON DISTRIBUTION SYSTEM



The following has been taken from an instruction sheet prepared by the Bureau of Water and Sewerage of Akron, Ohio, for use in the Fire Dept. School of Akron and supplied us by W. R. LaDue, Chief Engr. and Supt. of the Bureau of Water and Sewerage of Akron.

INSTRUCTIONS

1. Select a group of three hydrants —A, B, C.
2. Place gauge on center hydrant (B) blow off air and observe "static" (normal) pressure.
3. On a dead end place gauge on last hydrant and flow next to last hydrant.
4. Open other hydrants (A & C) and after steady flow has been obtained observe "residual" pressure at center hydrant (B).
5. Observe pitot pressures at flowed hydrants (A & C).
6. Check diameter of nozzles.
7. Tabulate total flow (see table) and pressure drop (static-residual).
8. From table compute total flow with 20 pounds residual.

FLOW TABLE

(Disch. of Std. 2½ in. Outlet at Various Pressures.)

Pressure Pounds	Flow GPM	Pressure Pounds	Flow GPM
2	240	18	710
5	380	20	750
10	530	22	790
15	650	24	820

FIELD RECORD FORM

Date 11-26-45 Time 9:30 A.M.

Hydrant - Pressure

Location (B)—Cor. 1st & N. St.
Static Pressure—78 pounds.
Residual Pressure—28 pounds.

Hydrants - Flowed

Location (C)—Cor. 1st St. & O. St.
Pitot Pressure — 24 pounds.
Diameter of Nozzle — 2½ in.
Flow, G. P. M. — 820 (table).

Location (A) — Cor. 1st & M. St.
Pitot Pressure — 17 pounds.
Diameter of Nozzle — 2½ in.
Flow, G. P. M. — 690 (table).

Computation of Flows Obtainable At 20 Pounds Residual Pressure

(1) Computed Flow = Observed Flow × Factor (y) in Table.

(2) Ratio $X = \dfrac{\text{Static} - 20 \text{ lb. Residual}}{\text{Static} - \text{Residual Press. Observed.}}$

In above example —

$$X = \frac{78 - 20}{78 - 28} = \frac{58}{50} = 1.16$$

Recorded flow as observed in test (table above) —

(A) 690 + (C) 820 = 1510 G.P.M.

To convert to computed flow at 20 lbs. residual.

X (above) = 1.16

Factor (Y) = 1.08 (see table below)

Therefore—

Computed flow = Observed flow × Y.
= 1510 × 1.08
= 1630 G.P.M.

Values of "Y" for Ratio "X"

X	Y	X	Y
0.80	0.89	1.60	1.29
0.90	0.95	1.70	1.33
1.00	1.00	1.80	1.37
1.10	1.05	1.90	1.41
1.20	1.10	2.00	1.45
1.30	1.15	2.25	1.57
1.40	1.20	2.50	1.64
1.50	1.24	3.00	1.81

MICHIGAN SEWAGE WORKS ASSN. HOLDS 21st ANNUAL CONFERENCE AND SHORT SCHOOL*

Attendance Tops Ninety at Lansing, Mich.

President

Outgoing
Paul Stegeman
Supt. of Sewage
Midland

Incoming
R. A. Green
Operator
Jackson

WITH a conference registration of 92 and an attendance of 25 at the annual short School, the 21st Annual Conference of the Michigan Sewage Works Association added another successful chapter to the history of that organization.

The theme of this year's conference was "operation," and was of particular value to the many new operators who were in attendance.

Business Meeting

At the annual business meeting, R. A. Green, Jackson, Mich., was elected President to succeed Paul Stegeman, Supt. of Sew. Treat., Midland, Mich.

The Kenneth Allen Award of the Federation of Sewage Works for the Michigan Association was made to Thomas J. Doyle, Supt. of Sewage Treatment, Pontiac, Mich., for his active work with the Michigan Sewage Works Assn. since 1924.

*Report based on notes and photos supplied by Kenneth W. Cosens, Asst. Prof. of Civil Engineering, Michigan State College, Lansing, Mich.

Programmers
Gerald Forton, Supt. Sew. Treat., Traverse City (left)
Donald M. Pierce, San. Engr., Mich. Dept. of Health (right)

The annual banquet held at the Porter Hotel drew an attendance of more than ninety, many of whom were wives. Speaker of the evening was Dr. W. L. Mallmann, Prof. of Bacteriology, Michigan State College.

Technical Sessions

Meeting in the Horticultural Building of Michigan State College, the technical sessions began with a talk on "Maintenance Problems in a Large Sewage Treatment Plant" by Virgil Anderson, Engineer of Sewage Treatment, Detroit, Mich. This was followed by a paper on "Treatment and Control Methods for Industrial Wastes" by L. F. Oeming, Sanitary Engineer, Michigan Stream Control Commission.

Kenneth Allen Award
Thomas J. Doyle
Supt., Sew. Treat.
Pontiac

Safety and Safe Practices

One whole session was devoted to the subject of "Safety in Sewage Treatment Plant Operation," with the first talk on this subject being made by Dr. William G. Fredrick, Industrial Hygienist and Chief Chemist, Bureau of Industrial Hygiene, Detroit Dept. of Health.

Arthur Jennings, City Director, Monroe, Mich., and Gerald Forton, Superintendent, Sewage Treatment Plant, Traverse City, told of experiences in "Explosions at Sewage Treatment Plants." A "Demonstration of the Use of Safety and Protective Equipment" was made by C. A. Habermehl, Supervising Sanitary Chemist, Sewage Treatment Plant, Detroit.

Speakers

Virgil Anderson
Engr., Sew. Treat.
Detroit

Dr. W. L. Mallmann
Prof. of Bact.
Mich. State College
Lansing

Sewage Plant Operation

In the symposium on Sewage Treatment Plant Operation, Thomas J. Doyle, Pontiac, spoke on Sludge Digestion Tanks; Stanley Bower, Ypsilanti, presented a paper on Sedimentation Tanks; and Kenneth Fishbeck, Sanitary Engr., Lansing, discoursed on the "Design and Operation of Sewage Regulators." In the same session, Prof. G. M. Ridenour, Resident Lecturer in Public Health Engineering, School of Public Health, University of Michigan, explained the "Fundamental Conceptions and Significance of Terms Used for Sewage Plant Loading and Effidiency Measurements," covering such items as suspended solids and B.O.D. loading, per cent removals, loadings in pounds per sq. yd. and per cu. yd. of sprinkling filters among many others.

Short School

The three day short school included lectures and laboratory work on chemical and bacteriological

A Conference Session
The "Old Maestro of Michigan," Jim Rumsey, occupies a front row seat.

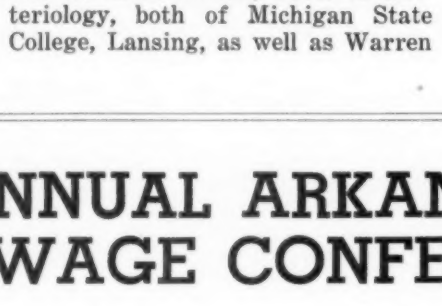
analyses, as well as lectures on Sludge Digestion, and Activated Sludge. The students were divided into four groups, each group covering certain types of analyses. All groups received the general chemistry lectures and the lectures on sludge digestion and activated sludge. The instructional staff for the Short School included Frank R. Theroux, Prof. of Civil Engr., and Dr. W. L. Mallmann, Prof. of Bacteriology, both of Michigan State College, Lansing, as well as Warren W. Dubay, Chemist, Pontiac Sewage Disposal Plant; C. T. Mudgett, Supt., Muskegon Sewage Treatment Plant; R. A. Green, Sewage Treatment Plant, Jackson, and C. P. Wichter, Supt., Sewage Disposal Plant, Ann Arbor.

FIFTEENTH ANNUAL ARKANSAS WATER AND SEWAGE CONFERENCE*

100 Attend Meeting in Fayetteville, Ark.

RETURNING to Fayetteville after four years, the Fifteenth Annual Arkansas Water and Sewage Conference held an enthusiastic meeting April 15-17. Every paper on a carefully prepared program was presented by its author. Among phases especially emphasized were attention to the importance of sewage disposal and a report on the study being made of the unusual water resources of Arkansas.

Col. H. W. Streeter, Sanitary Engineer Director, Officer in Charge, Water and Sanitation Investigation Station, U. S. Public Health Service, Cincinnati, Ohio, discussed stream sanitation, and most of one session was given to a consideration of sewage disposal plants. It was emphasized that proper disposal is essential not only for sanitary and industrial reasons, but to maintain the attractiveness of the streams which have so important a part in the visit of tourists. It was unanimously voted that within the Conference there be established a section of the Federation of Sewage Works Associations. Mr. F. L. McDonald, recently returned from the army to his old position as chief sanitary engineer, Arkansas State Board of Health, was elected director of this section.



Officers

R. W. Spencer—Chairman Elect
Harrison Hale—Secretary
Edgar T. Brown—Retiring Chairman

The discussion on Arkansas' water resources brought out the cooperation of the University Bureau of Research and of the United States Geological Survey. Marvin C. Turner of Austin, Texas, chairman of the Southwest Section AWWA, brought greetings from the section and made a helpful talk on "Water Works Operation, A Profession." The following officers were elected for the coming year: Chairman, W. R. Spencer, Fayetteville; Vice-Chairman, J. R. Pierce, Pine Bluff; Secretary, Harrison Hale, Fayetteville. Executive Committee Chairman, W. R. Spencer, Fayetteville; Gaston F. Bell, Bauxite; W. G. Check, Gravette; T. E. Farabough, Dumas; Fay Peer, Van Buren; Neal B. Thayer, Jonesboro.

*Brief report from Harrison Hale, Secy. of the Arkansas Water & Sewage Conf.

15th Arkansas Water and Sewage Conference, April 16, 1946

WATER AND SEWAGE CHEMISTS MEET

THE division of Water, Sewage and Sanitation Chemistry of the American Chemical Society held its semi-annual meeting in conjunction with the regular meeting of the American Chemical Society at Atlantic City, N. J., on April 9.

Under the chairmanship of **Dr. C. C. Ruchhoft,** principal chemist of the U. S. Public Health Service, Cincinnati, the meeting covered a variety of topics. Brief abstracts of the various papers follow.

Standard Methods of Analysis

Dr. A. M. Buswell, Chairman of the American Chemical Society Committee on Methods for the Examination of Water and Sewage, and Chief of the Illinois Water State Survey, Urbana, Ill., gave a "Preview of Forthcoming Standard Methods for the Examination of Water and Sewage," stating that several changes in editorial policy and format have been adopted for the forthcoming ninth edition.

Prof. H. O. Halverson, of the Dept. of Bacteriology and Immunology at the University of Minnesota, described a new chemical method for the measurement of complete oxygen demand of waste samples, based on the oxidation of organic matter with iodic acid formed by the addition of sulphuric acid to potassium iodate. The residual iodate not utilized for the oxidation is measured iodometrically. Large amounts of chlorides introduce some error.

Dr. R. S. Ingols of the University of Michigan, School of Public Health, Ann Arbor, Mich., reported on results of an investigation of the "Effect of Storage of Sewage Upon Its B.O.D." Dr. Ingols' work was similar to that published by Dr. Hatfield and others in past years, but his conclusions indicated that the true B.O.D. value of a sewage can only be determined at the time of sampling, for storage even under refrigerated conditions permits changes of considerable magnitude. This conclusion seems to be at variance with previous work.

Chlorine Demand of Sewage

Dr. H. Heukelekian, of the Dept. of Sewage Research in the New Jersey Agricultural Experiment Station, New Brunswick, N. J., read a paper on "The Utilization of Chlorine During Septization of Sewage." Dr. Heukelekian pointed out that both the chlorine demand and sulfide content of sewage increase with septicity, and that whereas in fresh sewage nearly all of the chlorine demand is due to substances other than sulfides, in septic sewage 20 to 27 per cent of the demand is due to sulfides. It appears that these relative percentages remain constant irrespective of the stage of septicity and despite the increase in chlorine demand. In order to remove sulfides completely from septic sewage, 75 per cent of the chlorine demand must be satisfied while 20 to 40 per cent of the chlorine demand of fresh raw sewage may be satisfied and thereby prevent sulfide production. Thus the higher percentage required along with the higher chlorine demand of sewage necessitates the addition of ten times as much chlorine for the removal of sulfides after they are produced, than for their prevention by chlorination of fresh sewage. The wastage of chlorine is due to the fact that only 25 to 30 per cent of the chlorine added reacts with the sulfides.

Industrial Wastes

Lewis B. Miller of W. H. and L. D. Betz Co., Philadelphia, Pa., told of an example of complete treatment and disposal of cannery waste. Complete removal of all pollution to the small receiving stream was accomplished by installation of a simple treatment system coupled with operational changes in the canning process. Disposal of solids was accomplished by utilizing a part of the solid waste for stock food and the remainder for soil fertilization.

Dr. W. W. Hodge, Senior Fellow, Mellon Institute, Pittsburgh, reported on "Investigations of Drainage from Bituminous Coal Mines." These investigations were part of a program to develop methods for the abatement of stream pollution by acid mine drainage inaugurated by the Bituminous Coal Research, Inc., in 1944 with a research fellowship in the Engineering Experiment Station at West Virginia University. The results of the studies to date were given, and possible methods for reducing stream pollution by acid mine drainage were discussed. The problem is very serious in the Ohio River basin and other areas.

Richard D. Hoak, Senior Fellow of Mellon Institute of Industrial Research, Pittsburgh, gave the third in a series of papers dealing with the lime treatment of waste pickle liquor. In general, the rate of reaction is substantially greater with high calcium than with dolomitic limes. Dolomitic limes, however, have basicity factors approximately 20 per cent higher than high calcium limes, and this is an equalizing factor. Many factors influence the effectiveness with which pickle liquor can be treated with different limes, and he presented data as a guide to the general nature of this type process for treating pickle liquor.

H. Gladys Swope of Mellon Institute presented the results of experiments on "Chemical Treatment of Deinking Wastes" in the paper industry. This study is one of the first begun by the National Conference for Stream Improvement and the Pulp, Paper and Paper Board Industry. It appears that the most economical chemical or combination of chemicals depends on the type of paper being deinked.

Water Treatment

H. L. Tiger of the Permutit Company presented a paper on "Desalting Sea Water," explaining and demonstrating the development and use of the desalting briquets and reaction bag used by a large number of fliers during the war.

Other papers included the "Determination of the pH of Saturation of Magnesium Hydroxide," by **J. W. Ryznar,** Jerome Green and M. G. Winterstein, National Aluminate Corp., Chicago, and the "Filtration of Water Through Diatomaceous Earth" by **S. B. Applebaum,** Permutit Co., New York, N. Y.

H. M. Olson of the Ohio Salt Co., Pittsburgh, Pa., read a paper on "Industrial and Municipal Water Treatment and Reuse of Water," in which he stated that all classes of water treatment equipment had had a great impetus during the four year war period with probably a three to four-fold increase over former years. During the war, over 135 new municipal water softening plants were installed. The total number of municipal water softening plants as of January 1 was 710, about 35 per cent of which are of the zeolite type.

In the field of water reuse, it appears that this practice will produce great savings to prevent rapid depletion of our water tables. The use of water for cooling purposes and recharge of ground water supply were among the ideas presented.

HIGH CAPACITY TRICKLING FILTERS

Part III—Two Stage Filters

By J. A. MONTGOMERY
Chief Engineer
LAKESIDE ENGINEERING CO.
CHICAGO, ILL.

This study and interpretation of single and two stage high capacity trickling filter operation, and the causes for poor results, is necessarily of considerable length. In order to simplify its presentation, this article has been divided into three parts. To further simplify the presentation, the cuts, conclusions, and references are numbered consecutively in the three parts. The subtitles of the three parts are: Part I—Single Stage Filter Operation and Results; Part II—Causes of Poor Performance in Filter Operation; Part III—Two Stage Filters.

THERE is an increasing demand for sewage plants that will properly handle various types of trade wastes, either alone or mixed with municipal sewage. Part III of this series of articles on trickling filters deals with two-stage filters, predicted results and how these results are affected by filter loadings and the relative sizes of the filters in each stage.

The Author

Curve A of Fig. 2 (Part I) was developed by means of B.O.D. data from eight different municipal Aerofilter sewage plants and represents in excess of 600 individual analyses. Since the publication of the original curve[17] in 1942, additional data from other properly *designed* and *operated* plants have shown the curve to be approximately correct. The curve shows that a single stage filter is capable of removing upwards to 78 per cent of the applied settled sewage B.O.D. without parallel recirculation, provided the load is held to within 2 lb. of B.O.D. per cu. yd. of media. In contrast, two-stage filters can be made to remove in excess of 90 per cent of the applied settled sewage B.O.D., depending on the load applied per cu. yd. and the relative filter sizes.

As pointed out in Part I,* a better effluent can be produced by a single stage filter treating 1 mgd. of 200 ppm. settled sewage B.O.D. than can be obtained in treating 0.5 mgd. of 400 ppm. B.O.D. unless heavy recirculation is used with the stronger waste. If the filter removes 78 per cent of the applied B.O.D., the 1 mgd. would give an effluent of 44 ppm., whereas the 400 ppm. settled sewage would have an effluent with an 88 ppm. B.O.D. If the half million gallons of 400 ppm. settled sewage B.O.D. were to be handled by a two-stage filter installation, the plant effluent could be reduced to 25 to 30 ppm. without the use of parallel recirculation. Thus it seems logical to employ two-stage operation for strong wastes, unless heavy parallel recirculation is used with single stage.

Just why the two-stage installation produces far better results than the single stage filter, when using the same total quantity of filter media, is not quite clear. There are several possible contributing factors. Perhaps a segregation of the filter flora and fauna into two phases plays an important part. Furthermore, the waste sludge from the first stage is removed by intermediate clarification and this keeps the active media in the second stage in a better condition. It is generally agreed that the top layers of filter media are more efficient than the lower layers of media. If this is the case, in a two-stage plant there are two top surfaces instead of one.

Effect of Loading on B.O.D. Removal by Two-Stage Filters

Fig. 5 has been produced by means of calculations made from Curve A of Fig. 2. It was assumed that the B.O.D. removal by the first stage filter will adhere to Curve A and that the efficiency of the second stage filter will run about 85 per cent of the efficiencies shown by Curve A. Naturally these efficiencies would not hold for weak sewages, but they probably can be equalled or bettered when treating strong wastes with properly designed and operated two-stage plants. Regardless of whether the removal efficiency for the second stage is figured at 85 or 90 per cent of Curve A of Fig. 2, the same relationship would hold for the various curves shown in Fig. 5 provided the same efficiency factor is used for all of the curves of Fig. 5.

It is interesting to note that the total B.O.D. removal by the two stages depends on the pounds of settled sewage B.O.D. applied per cu. yd. of the total media used in both

TABLE XIII

Austin, Minnesota—Two Stage Plant, with housed filters

First Stage: Low momentary rate using film spray application; Second Stage: Low capacity filters with fixed nozzles.
No recirculation is used.

	1940					1941				
	May	June	July	Aug.	Sept.	July	Aug.	Sept.*	Nov.	Dec.
Avg. M.G.D. raw sewage	3.07	3.16	3.08	3.26	3.14	3.342	3.51	3.499	3.805	3.605
M.G.A.D.										
1st Stage	18.5	18.9	18.5	19.5	18.8	20.6	21.0	20.9	22.8	21.6
2nd Stage	3.36	3.46	3.38	3.56	3.44	3.65	3.83	3.93	4.16	3.94
Ppm. B.O.D.										
Raw sewage	594	520	628	531	614	483	586	531	746	732
Primary effl.	340	297	383	356	465	390	448	409	574	559
Int. effl.	150	136	187	193	290	220	276	232	379	373
Final effl.	52	32	39	37	56	53	36	41	117	106
Pounds B.O.D.										
Raw sewage	15,200	13,700	16,200	14,450	16,100	13,450	17,150	15,470	23,470	23,800
Prim. effl.	8,700	7,820	9,880	9,650	12,200	10,750	13,100	11,917	18,200	16,800
Int. effl.	3,840	3,580	4,820	5,240	7,600	6,120	8,080	6,783	12,050	11,490
Final effl.	1,330	844	1,005	1,005	1,440	1,475	1,052	1,183	3,720	3,180
Lbs. B.O.D. per cu. yd. rock settled sewage basis										
To total rock	0.633	0.57	0.721	0.703	0.89	0.786	0.955	0.872	1.33	1.28
To first stage	5.39	4.84	6.10	5.98	7.57	6.68	8.12	7.40	11.28	10.40
To second stage	0.317	0.296	0.398	0.432	0.628	0.505	0.668	0.56	0.997	0.944
Percentage B.O.D. reduction of load applied										
By primary	42.7	42.9	39.0	33.2	24.2	20.1	23.6	22.9	22.2	29.4
By first stage	56.0	54.2	51.2	45.8	37.7	43.0	38.3	43.0	33.8	32.1
By second stage	65.4	76.3	79.0	80.7	81.0	76.0	87.0	82.5	69.2	72.0
By both filters applied load basis	84.9	88.9	89.8	89.6	88.4	86.0	92.0	90.1	79.4	81.0
By entire plant	91.0	94.0	93.7	93.0	91.0	89.0	93.8	92.3	84.0	86.8

*Three 24 hour tests by Walton.

*Part I—Single Stage Filter Operation and results. J. A. Montgomery, *Water and Sewage Works*, p. 35, Jan. 1946.

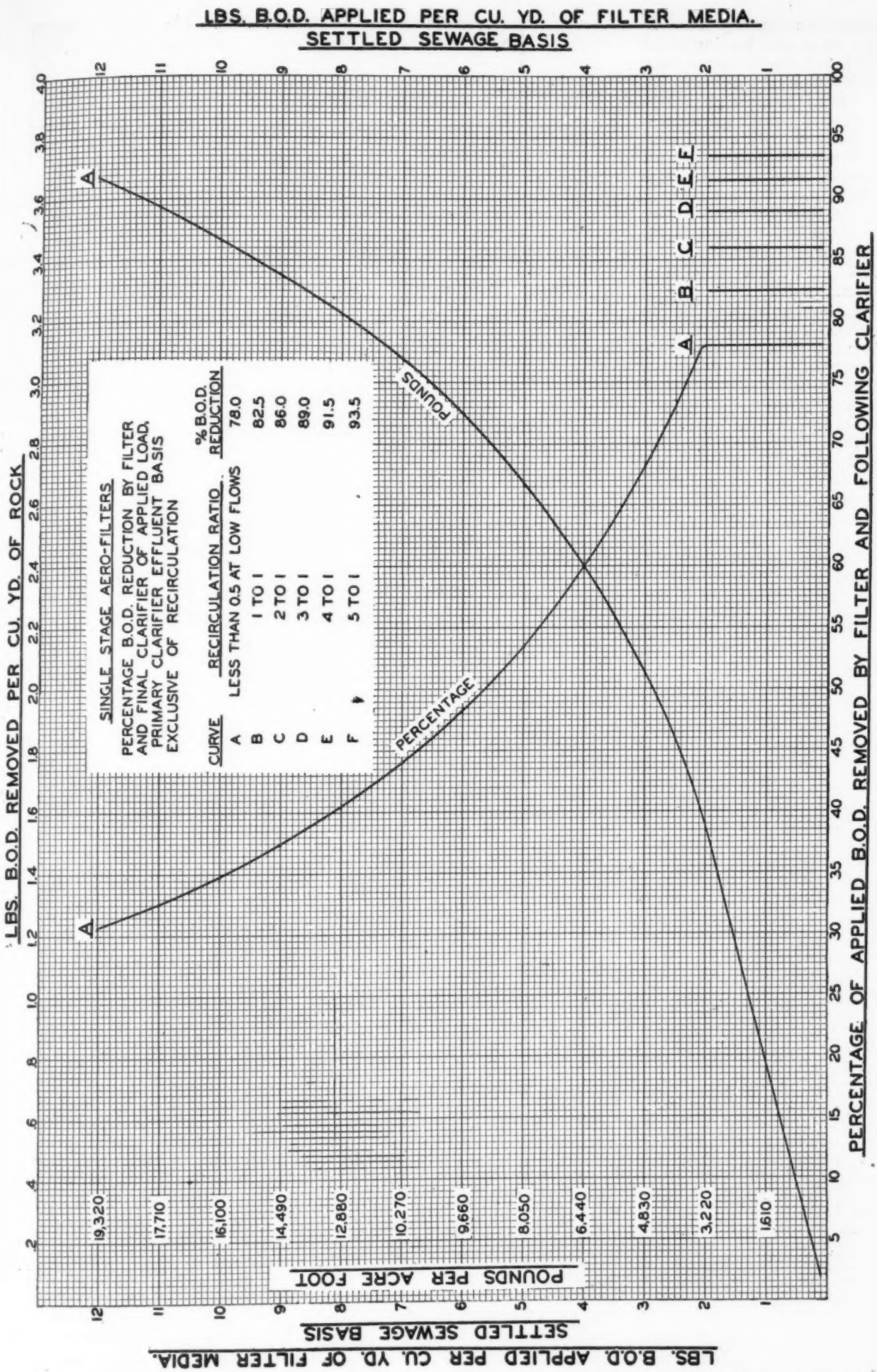

LBS. B.O.D. APPLIED PER CU. YD. OF FILTER MEDIA.
SETTLED SEWAGE BASIS
LBS. B.O.D. REMOVED PER CU. YD. OF ROCK
POUNDS PER ACRE FOOT
PERCENTAGE OF APPLIED B.O.D. REMOVED BY FILTER AND FOLLOWING CLARIFIER
A B C D E F
POUNDS
PERCENTAGE
SINGLE STAGE AERO-FILTERS
PERCENTAGE B.O.D. REDUCTION BY FILTER AND FINAL CLARIFIER OF APPLIED LOAD. PRIMARY CLARIFIER EFFLUENT BASIS EXCLUSIVE OF RECIRCULATION
CURVE | RECIRCULATION RATIO | % B.O.D. REDUCTION
A | LESS THAN 0.5 AT LOW FLOWS | 78.0
B | 1 TO 1 | 82.5
C | 2 TO 1 | 86.0
D | 3 TO 1 | 89.0
E | 4 TO 1 | 91.5
F | 5 TO 1 | 93.5

Fig. 2—Fundamental Relations Between Filter Loadings and Removals of B. O. D.

stages. Two high capacity filters in series with an applied loading of 1.5 pounds of B.O.D. based on the total media in both stages provide the same total B.O.D. removal as a high capacity filter followed by a large conventional filter with a total loading of 0.25 lb. of B.O.D. per cu. yd. of total media. See Curves A and E of Fig. 5.

If these curves are more or less correct, then it would seem wise to use high capacity filters in both stages and thus reduce the cost of the treatment plant.

The treatment plant at Austin, Minn. (Table XIII) has two Aero-filters in parallel in the first stage and a large fixed nozzle conventional filter in the second stage. There are 11.8 per cent of the total media in the first stage. In general, the removals by the filters at the various total loadings per cu. yd. of media are equal to or better than Fig. 5 indicates.

The results for Army Base III, Table XIV, where Aero-filters are followed by conventional filters with 4-arm distributors, are good, but practically all of the work is done by the Aero-filters. The total removals by the two-stage filters are somewhat below what Fig. 5 indicates they should be, based on an

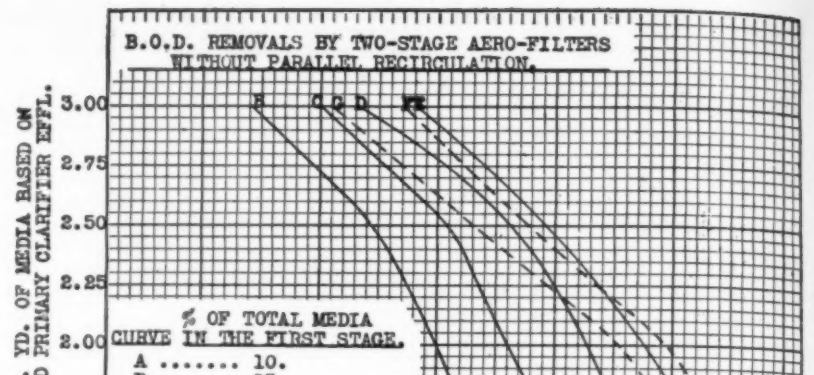


Fig. 5—B. O. D. Removal by Two-Stage Aero-Filters Without Parallel Recirculation

TABLE XIV

Two Stage High Capacity Filters—Low Momentary Rate Aero-Filters

Plant location	Webster City, Iowa (a)		Lakefield, Minn. (a)	Owatonna, Minn. (a)			Army Base III			Army Base E	
Dates of tests	Oct. 1941	Nov. 1941	Aug. 1941	Aug. Sept. 1941	Sept. 1941	Sept. 1941	Dec. 1943	Jan. 1944	Feb. 1944	May 1944	June 1944
Avg. of test numbers	1	2	1,2,3	1,2,3,7,8	5,6	4					
No. 24 hr. composites	1	1	3	5	2	1	24	25	23	19	8
M.G.D. Avg.											
Raw sewage	.272	.587	.0518	.604	.639	.743	2.03	2.14	2.12	0.84	0.825
Prim. clarif. effl.	.497*	.590	.0681**	.813	.705	.832	2.03	2.14	2.12	0.84	0.825
To 1st stage filters	.497*	.590	.0855*	1.055*	1.108*	1.235*	3.1*	3.1*	3.1	1.728*	1.728*
Int. clarif. effl.	.497*	.590	.0855*	1.025*	1.008*	1.174*	3.1*	3.1*	3.1	1.728*	1.728*
To 2nd stage filters	.497*	.590	.0681**	1.025*	1.008*	1.174*	2.03	2.14	2.12	1.728*	1.728*
Final effluent	.272	.587	.0681	.604	.639	.743	2.03	2.14	2.12	0.84	0.84
M.G.A.D. with recir.											
To first stage	17.3	20.3	8.35	17.4	18.2	20.3	18	18	18	18	18
To second stage	17.3	20.3	5.80	18.8	18.5	21.5	3	3	3	18	18
Recirculation ratio											
First stage	0.83	0.05	0.26	0.75	0.73	0.61	0.53	0.45	0.44	1.05	1.1
Second stage	0.83	0.05	0.00	0.70	0.58	0.58	0.00	0.00	0.00	1.05	1.1
Prm. 5-day B.O.D.											
Raw sewage	378	161	527	272	588	1300	284	300	218	473	545
Prim. effl.	182*	118	369**	174	478	1230	151	138	107	280	282
To 1st stage	182*	118	296*	126*	332*	1080*	...	...	...	...	...
Int. effl	94*	94	68**	36.4*	144*	860*	...	...	..	...	...
To 2nd stage	94*	94	68**	36.4*	144*	860*	38	33	29	114*	114*
Final effluent	52	25	25.7	24.4	61	790	27	22	21	36	30
Pounds of B.O.D.											
Raw sewage	857	787	228	1370	3135	8050	4820	5350	3860	3310	3750
Prim. effl.	755*	581	209**	1180	2810	8520	2560	2460	1890	1960	1940
W...	755	581	211	1165*	3 60*	11100*	...	...	...	...	...
With recirculation to second stage	390*	216	38.7***	311*	1200*	8430*	644	589	513	799	782
Final effluent	118	122	14.7	123	325	4890	457	393	371	259	206
Pounds B.O.D. Applied per cu. yd. media											
Raw sewage basis to total media	1.19	1.09	0.81	1.13	2.59	7.43	0.427	0.477	0.342	1.92	2.19
Prim. effl. basis to total media	1.05*	0.808*	0.743	0.975	2.32	7.01	0.227	0.219	0.168	1.14	1.13
To first stage	2.095*	1.61*	1.60**	1.62*	4.45*	16.2*	1.33	1.23	0.945	...	...
To second stage	1.08*	0.60*	0.285**	0.59*	2.28*	16.05*	0.07	0.0635	0.0555	0.928*	0.91*
Percentage B.O.D. Reduc.											
By prim. clarif.	11.9*	26.1*	8.34**	13.9	10.35	—5.83	46.8	54.0	51.0	40.3	48.2
First stage applied basis	48.3*	62.8*	81.5**	73.6*	60.7*	24.0*	74.8	76.2	72.9	...	...
Overall first stage	54.4*	72.6	83.0	77.2*	61.5*	...	86.6	89.0	86.8	...	...
Second stage applied basis	69.8*	43.4	62.0***	60.4*	72.9*	42.0*	29.1	33.3	27.7	67.6	73.7
By filters settled sewage basis	84.4*	78.5*	93.0	89.6	88.5	...	82.0	84.1	80.3	87.0	89.4
By entire plant	86.2	84.4	93.5	91.0	89.6	39.3	90.6	92.7	90.4	92.2	94.5

*Includes recirculation.
**Includes fine screen wash water from city faucet without recirculation.
***No recirculation is used to the second stage filter. Lakefield uses a fine screen instead of a primary clarifier.
Note: Webster City employs film application while all other plants use rain-drop. Army Base III has a conventional filter installation in the second stage, while other plants have high capacity filters in both stages.
(a) Graham Walton and John Wilson, "High Daily Rate Trickling Filter Performance," Ph. D. Thesis, University of Wisconsin, 1943.

TABLE XV

Detroit Lakes, Minnesota. Two Stage Trickling Filters (a)

Joint tests by U. S. Public Health Service and the State of Minnesota

Dates of tests	July 31-Aug. 1 1944	Aug. 1-Aug. 2 1944	Aug. 2-Aug. 3 1944
Avn. M.G.D.			
Flow to wet well following fine screen**	0.441	0.428	0.456
Supernatant return to wet well	0.00314	0.00252	0.00315
Total flow to filters	0.444	0.430	0.459
Ppm. 5-Day B.O.D.			
Fine screen effluent**	394.	237.	297.
Supernatant	139.	249.	300.
First stage effluent	43.	25.	51.
Final effluent	6.7	7.5	20.
Pounds of B.O.D.			
Fine screen effluent	1448.	847.	1130.
Supernatant	35.	53.	79.
Total to first stage filter	1483.	900.	1209.
To second stage filter	159.	98.6	195.
Final effluent	24.8	26.9	75.5
Pounds of B.O.D. applied per cu. yd. of filter media			
Based on total media	0.406	0.246	0.330
To first stage filter	3.27	2.02	2.66
To second stage filter	0.0497	0.028	0.069
Percentage B.O.D. reduction			
By first stage filter based on applied load	89.2	90.1	84.0*
By second stage filter based on applied load	87.5	70.1	61.4
By both filters, based on fine screen effluent plus the supernatant	98.1	97.1	94.1

*The supernatant probably affected the result.
**This plant uses a fine screen instead of a primary clarifier, and the first stage filter uses a tile media instead of rock.
(a) "Modernization of the Sewage Treatment Plant at Detroit Lakes, Minn.", Winston C. Larson, page 19, *Public Works*, February, 1945.

overall settled sewage B.O.D. of about 0.2 lb. per cu. yd. of media, but it should be noted that the sewage applied to the second stage is very weak, hence the removal in terms of percentage would naturally be low.

The plant at Lakefield, Table XIV, has two-stage Aero-filters with an applied overall settled sewage load in excess of three times Army Base III and gives the same quality of effluent B.O.D.

Army Base E, Table XIV, also has two-stage Aero-filters with an applied load of 1.14 and 1.13 lb. of B.O.D. per total cu. yd. of media. The results are not far from what Curve D of Fig. 5 indicates they should be. The total overall reduction by the entire plant is on a par with Lakefield. While considerable (unmeasured) recirculation is used, most of it occurs during the night when the flow of raw sewage is low.

The plant discharges into one of the best fishing streams on the Pacific Coast without giving any trouble or cause for complaint.

The results for Aug.-Sept. and for Sept. (column 2) at Owatonna also agree quite closely with Fig. 5 considering that the first stage filter contains 56 per cent of the total media and that the distribution of the sewage over both filters was very bad. The distributors were replaced in December, 1944.

All of the foregoing plants, as shown by Table XVII, use rain-drop application on the Aero-filters. The results at Webster City, Iowa, shown in Table XIV, fall far short of Figure 2. The distributors used at this plant do not provide rain-drop application.

The results at Detroit Lakes, Minn., given in Table XV, are excellent. Rain-drop application is used in both stages with a high capacity Aero-filter in the first stage and a conventional fixed nozzle filter in the second stage. The overall load is rather low, but the load to the first stage filter, which has a tile medium, is high. The removal by the first stage is very high but it should be remembered that the B.O.D. normally removed by a primary clarifier is passed on to the filter since a fine screen is used in lieu of a primary tank. The second stage filter is also doing an excellent job in view of the weak sewage being applied to it.

Relative Filter Sizes in Each Stage

In the past it has been common practice to put a small filter in the first stage and follow it by a conventional filter, as in the case of Austin, Minn., and Army Base III, or to put two high capacity filters in series using 50 per cent of the total media in each stage.

We were interested to know what the effect would be of placing various amounts of the total media in the first stage. Figure 5 shows the calculated B.O.D. reductions for a number of different filter loadings when using various proportions of the total media in the first stage. It appears that the first stage filter should be increased at the expense of the second stage, which is just the reverse of what has been done in the past. While it is not intended to convey the idea that Fig. 5 is a final conclusion, still with the limited data available for two-stage Aero-filters it appears well worth considering when designing two-stage plants.

Table XVI reveals that about the same B.O.D. loading will be applied to the second stage filter per cu. yd. of media, with an overall filter load of 1.5 lb., whether one uses 35, 50 or 65 per cent of the total media in the first stage. Fig. 5 shows that by placing 65 per cent of the total filter media in the first stage (Curve E), a better efficiency can be obtained since the overall load can be set at 1.5 lb. per cu. yd. of media, whereas if 35 per cent of the media is placed in the first stage the load would have to be reduced to 0.75 lb. per cu. yd. of media (see Curve C), to obtain equal results. When more than 65 per cent of the total media is placed in the first stage, the load to the second stage will exceed 1.0 lb. per cu. yd. of media, a condition which is not advisable when good effluents are desired.

If Curve A of Fig. 2 were a straight line, Fig. 5 would not hold, but Curve A indicates reduced filter efficiencies for loadings in excess of 2 lb. per cu. yd. of media. Hence, the percentage of media in the first stage affects the overall results. It is true that as the filter in the first stage is reduced in size for a given load, based on the total media, the pounds of B.O.D. applied and removed per cu. yd. of media is increased but the total pounds of B.O.D. removed by the first stage decreases, which in turn increases the load to the second stage filter.

TABLE XVI

B.O.D. Loadings to Each Filter Stage, Based on the Curves of Figure 4

Curve of Fig. 4	% of total media in 1st. stage	Stage	Pounds of settled sewage B.O.D. applied per cu. yd. of total filter media: 3.00	2.50	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25
			Pounds of settled sewage B.O.D. applied per cu. yd. in each stage									
A	10	1st.	31.20	25.00	20.00	18.20	15.60	12.50	10.00	7.50	5.00	2.50
		2nd.	....	....	....	....	....	0.98	0.73	0.47	0.26	0.073
B	25	1st.	12.00	10.00	8.00	7.00	6.00	5.00	4.00	3.00	2.00	1.00
		2nd.	2.78	2.18	1.59	1.31	1.04	0.77	0.53	0.33	0.15	0.075
C	35	1st.	8.56	7.14	5.72	5.00	4.30	3.57	2.86	2.14	1.43	0.072
		2nd.	2.83	2.17	1.55	1.25	0.97	0.70	0.47	0.26	0.17	0.085
D	50	1st.	6.00	5.00	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50
		2nd.	3.11	2.32	1.60	1.27	0.95	0.66	0.45	0.34	0.23	0.11
E	65	1st.	4.16	3.85	3.08	2.70	2.31	1.93	1.54	1.15	0.77	0.39
		2nd.	3.78	2.76	1.83	1.41	1.00	0.79	0.63	0.47	0.32	0.16
F	75	1st.	4.00	3.33	2.67	2.34	2.00	1.67	1.33	1.00	0.66	0.33
		2nd.	4.76	3.45	2.28	1.77	1.32	1.12	0.88	0.66	0.44	0.22
G	90	1st.	3.32	2.78	2.22	1.94	1.67	1.39	1.11	0.83	0.56	0.28
		2nd.	10.50	7.38	5.24	3.91	3.40	2.83	2.50	1.65	1.10	0.55

Recirculation

It should be remembered that there is a wide difference between parallel and non-parallel recirculation. In the first case it is used for dilution purposes, whereas in the case of non-parallel recirculation it is used during periods of low raw sewage flows, and then only to augment the flow of raw sewage in sufficient amounts to provide proper distributor operation.

Fig. 6 shows the general methods employed for recirculation in two-stage operation. Of course, modification of these general methods may be employed.

Method E, which is normally used with two-stage Aero-filter installations, is the only method which lends itself to determining the load applied to each filter without including the recirculated liquor. Method G was tried at Owatonna, Minn., by Walton,[4] who found that the sludge from the first stage filter caused ponding on the second stage. Any benefits that might have been obtained by recirculation were offset by a lowered filter efficiency in the second stage.

Conclusions

10. Two-stage trickling filters will give much better reductions of the B.O.D. than single stage using the same total quantity of media.

11. Since the ppm. B.O.D. in the plant effluent is a function of the applied strength, the quality of the effluent required should be determined first, and the plant designed accordingly.

12. Two high capacity filters in series and separated by an interme-

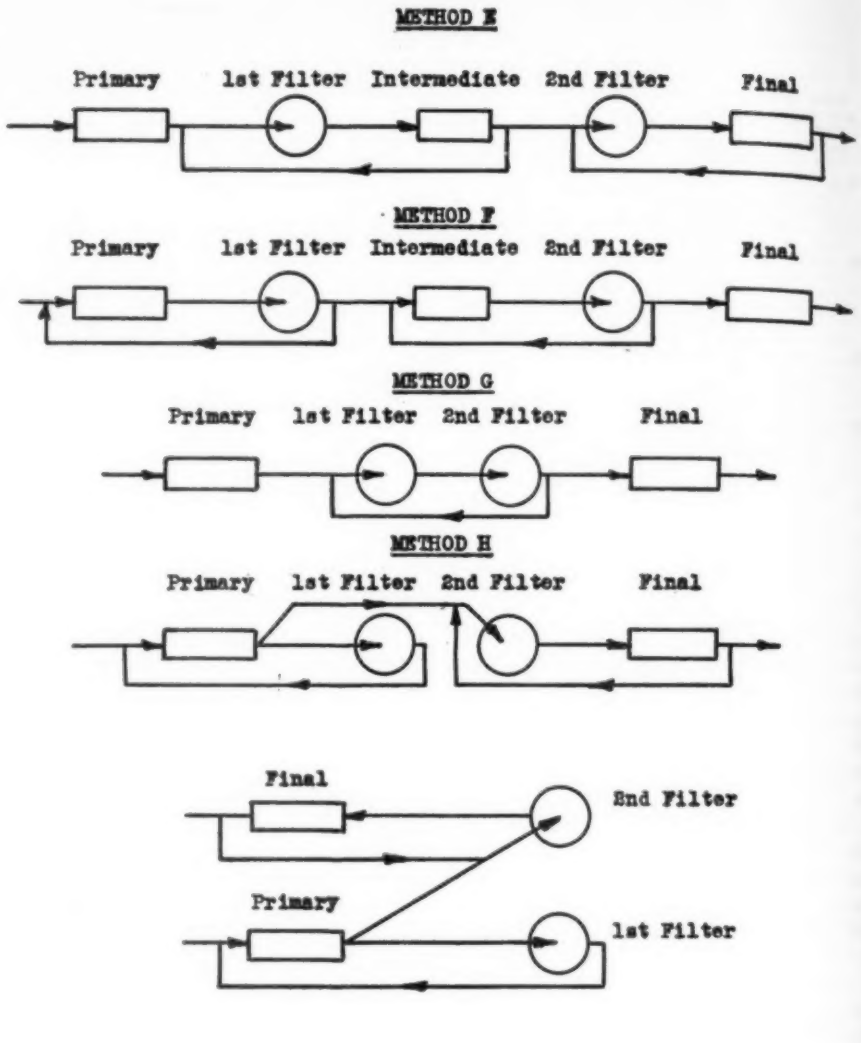


Fig. 6—Two-Stage Recirculation

TABLE XVII

Tabulation of Equipment at Plants Cited

	Army Base, Ill.	Army Base E.	Austin, Minn.	Detroit Lakes, Minn.	Lakefield, Minn.	Owatonna, Minn.	Webster City, Iowa
Percentage of Total Media in First Stage	17.6	50	11.8	12.8	50	56	50
First Stage Filters							
Type of filter	Aero	Aero	Aero	Aero	Aero	Aero	Aero
Type of distributor	YBC.	YBC.	4A.	YBC.	YBC.	YBC.	8A
Application method	RD.	RD.	F.	RD.	RD.	RD.	F.
Kind of media	Rock	Rock	Rock	Tile	Tile	Tile	Rock
Filter area, sq. ft.	7696	4657	7264	2043	491	2642	1256
Depth, ft.	7	5	6	6	7	7	7.75
Cu yds. of media	2000	862	1614	454	131	677	360
Housed or unhoused	U.H.	U.H.	H.	H.	H.	H.	U.H.
Method of recirculation	E.	E.	None	None	E.	E.	F.
Second Stage Filters							
Type of filter	C.	Aero	C.	C.	Aero	Aero	Aero
Type of distributor	4A.	YBC.	FN.	FN.	YBC.	YBC.	8A
Application method	F.	RD.	RD.	RD.	RD.	RD.	F.
Kind of media	Rock	Rock	Rock	Rock	Rock	Rock	Rock
Filter area, sq. ft.	30,786	4,675	38,590	10,864	491	2,376	1,256
Depth, ft.	8.2	5	8	8	7	6	7.75
Cu. yds. of media	9,350	862	12,100	3,200	131	528	360
Housed or unhoused	U.H.	U.H.	H.	H.	H.	H.	U.H.
Method of recirculation	None	E.	None	None	None	E.	F.

A—Arms.
YBC—Multiple arms with Y branches equipped with centrifugal nozzles.
C—Conventional filter.
FN—Fixed nozzles.
RD—Rain-drop.
H—Housed.
UH—Unhoused.
For methods of recirculation see Fig. 5.

diate clarifier apparently will give as high reductions of the B.O.D. as a high capacity filter followed by a large conventional filter.

13. The relative sizes of the filters in the two stages seems to be important. Efficiencies in B.O.D. removals improve as the first stage filter is enlarged at the expense of the second stage. First stage filters containing more than 65 per cent of the total media are not recommended since the load to the second stage is increased too much, as shown by applied loads of 1.5 pounds per cu. yd. for Curves F and G of Fig. 5.

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Canada Beckons in October!

Sewage Works Federation Convention in Toronto—October 7-9

Arrangements for the Nineteenth Annual Meeting of the Federation of Sewage Works Associations, to be held in Toronto, Canada, on October 7-9, 1946, are well under way, according to Dr. A. E. Berry, Chairman of the Convention Management Committee, and immediate Past-President of the Federation. Owing to the omission of the regular annual meeting of the Federation membership-at-large in 1945, a record-breaking attendance is expected at the Toronto convention.

Host to the Federation at this meeting will be the very much alive Canadian Institute on Sewage and Sanitation, now the fourth largest unit of the Federation. Although the convention headquarters and exhibits will be set up in the Hotel Royal York, the Canadians are unselfishly planning to utilize accommodations at the King Edward Hotel so as to conserve hotel quarters at the Royal York for those attending from the States.

Selection of Monday, Oct. 7, through Wednesday, Oct. 9, as the meeting dates, instead of later in the week as in the past, is another move to facilitate the housing of registrants. This decision was reached after due consideration of Canadian experience in the most successful handling of large conventions.

The technical program is taking shape under the leadership of F. W. Gilcreas, Chairman of the Publications Committee. Plans are under way for papers on the following topics: Experiences with Activated Sludge Treatment at Toronto; Control of Scum in Digesters; Dual Disposal of Garbage and Sludge; Incineration Problems; Direct Heating of Sludge—a New Development; and Sewage Works Financing. Other papers will feature industrial waste treatment and stream sanitation problems. The "Operators' Breakfast Forum," a popular program feature in the past, will be conducted under the leadership of the Canadian Institute on Wednesday morning.

The Federation's Board of Control will hold its customary pre-convention business meeting on Sunday, Oct. 6, after which members of the Board will be guests of the Canadian Institute at a dinner the same evening. The regular post-convention business session of the Board will be held on Wednesday afternoon, after the close of the technical sessions.

Indications point to the largest and most interesting exhibits yet to be staged by the Water and Sewage Works Manufacturers' Association at any meeting of the Federation. All details of the exhibits are being supervised by Arthur T. Clark, Secretary-Manager of the manufacturers' association.

Persons planning to attend the Nineteenth Annual Meeting of the Federation (and likewise all hopefuls) are urged to make reservations either at the Royal York or the King Edward Hotel without delay. All rooms at the Royal York are equipped with twin beds. To conserve accommodations, arrange with a friend to share a room and make reservations accordingly. Reservations can always be cancelled later should it be found that plans to attend must be abandoned for any reason.

Many of you who will read this have not had a genuine vacation for some time. If you have never seen Canada in its autumnal splendor of October, here is a real opportunity—a postwar vacation in Canada, where folks are friendly and your dollar goes further.

L. H. Enslow, *Chairman*
Committee on Publicity and Attendance

How to Measure Accurately*

Here is a simple and valuable little kink that isn't as well known as it should be. A measurement that often ends in disaster because it is not accurately made involves the exact distance between two walls or objects which cannot be measured directly with a rule, cannot be measured with a stick that is too long, or with a stick that is too short.

An excellent kink for obtaining the *exact* distance is shown in the accompanying sketch. Use two sticks such as laths or anything else sufficiently stiff. The total length of the two must be somewhat greater than the distance between the walls or objects being measured so that they will overlap as shown. Put them together in contact as indicated and slide outward until the two ends "just touch" the desired limitation points. Then clamp or fasten them together as shown and you have the exact distance—as accurate as can be obtained even by use of a micrometer and more accurate than most methods.

This method is decidedly better than the cut and try methods that are commonly used.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

The Editor's Comments

Water Rates—Where Do We Stand?

Last week in St. Louis the American Water Works Association held what many have catalogued as its greatest convention of all time.

What with the record breaking paid registration, the outstandingly impressive exhibits of equipment and materials of tomorrow, and the well rounded out program of papers and discussion, we are ready to agree that AWWA's 1946 convention perhaps has topped them all.

Amongst the several top-flight papers presented there was one that was considered by many to be the most important single paper of the convention. The paper in question dealt with a study of water works construction and operating costs of pre-war years in comparison with those of the present; and, more importantly, those predictable for the first decade of the post-war period. The meat of this clean cut analysis was found in the predictable necessity for a general increase in water rates if water utilities are to meet construction, maintenance and repair requirements and continue to operate on anything like a self supporting basis. The impressive analyst was Louis R. Howson of Chicago, a designing and consulting engineer, an owner and operator of water works properties, and a past-president and "wheel-horse" in AWWA.

Amongst the many important disclosures in Mr. Howson's keen minded analysis and discussion the following highlights appear.

As of today, water works construction costs are double what they were in 1932. History of cost trends following two previous wars point to the fact that such costs will level off in the next decade at between 60 and 75% above those of 1939. Present costs are 62% above those of even the boom year 1929.

In arriving at his predictions of things to come, Mr. Howson employed statistics and data procured from 100 operating water utilities, representing a total investment of almost $800,000,000, about evenly divided between the municipal and the private plants making up the one hundred. During the two decades (1925-1945) the invested capital interestingly enough had grown by only 39% ($4,212,345) in the case of private plants as compared to 107% ($7,619,811) in the case of municipal plants. These figures represent an average annual capital expenditure of $11.10 per consumer by the municipals as against only $4.15 by the private plants—the average for the 100 plants being $7.00 capital expenditure per consumer per year during the 20 years 1925-1945. On a "population served" basis this investment of $7.00 per consumer per year represents $1.34 per capita per year for new construction. Based upon 80,000,000 people having public water supply service in the U. S., water utilities have been spending roughly $120,000,000 yearly for water supply betterments. To provide this same rate of construction at present would cost not less than $200,000,000 and probably the cost will be $250,000,000 before the full effects of present labor wage policies have been felt.

Mr. Howson then revealed that whereas in the two decades (1925-1945) invested capital in the 100 properties studied had increased 67%, the number of consumers had increased only 27%, reflecting the improved condition of water utility properties in general to an extent far beyond the growth rate of water takers and gross income. To-wit—

	Per Consumer		
	(1925)	*(1945)*	*Increase*
Gross Revenue	$26.15	$32.10	$5.95
Operating Expense*	12.70	17.45	4.75
Net Income*	13.45	14.65	1.20

*Before charging off depreciation.

From these statistics it is plain to see that in the 20 year period the gross increased 23% while operating expense rose 37%. *The net income gain has been a paltry* 9%. During this period the invested capital has increased from $238 per consumer to $310 per consumer—a 30% increase, which is to say that the rate of return on invested capital suffered a real reduction over the 20 year period.

As previously pointed out, for the 100 plants studied the capital additions averaged $7.00 per consumer per year, while the net income reached its highest in 1945 at $14.65 and averaged about $14.00. Thus, 50% of the net was plowed back into the properties.

Operating expenses have been growing more rapidly over the 20 year period than income. In 1925 operating expenses took 48½% and in 1945 the amount was 54½%. Since labor costs are approximately 45% of total operating costs, if water works labor is to receive the 17½% boost now being set by the "national policy" pattern, this likely increase must be taken into consideration. In addition it seems highly probable that with the ending of the present coal miners' strike, fuel or power cost is to rise by 10%. Then, too, materials, supplies, taxes, etc., may be expected to increase by roughly 15%. The picture gotten from these considerations is the following:

Increasing Costs	*Per Consumer*
Fuel or power at 10% of 13½% of operating cost	$0.24
Labor increase at 17½% of 45% of operating cost	1.38
Other materials and supplies at 15% of 41½% of operating cost	1.08
	$2.70

In other words, an increase in operating cost can be expected to reach $2.70 per consumer per year before much longer—approximately a 15½% increase in operating expense. This increase will reduce the net income of $14.65 per consumer to $11.95 in 1946. However, since net income of today will purchase only about 67% as much construction as in 1940, and since about 50% of net has been required for other than new construction, it can be assumed that at least this ratio, or $7.30 per consumer, will be needed in the future.

If this required $7.30 is deducted from the $11.95 estimated net income of the near future, there is left but $4.65 per consumer per year for new construction. To increase this to the $11.20 per consumer needed to continue betterments at the rate prevailing during the past 20 years, an additional gross revenue of $6.55 per consumer per year is needed.

In round figures this needed increase amounts to 20% of present gross revenue or $1.40 per capita. Thus, by the above carefully drawn analysis of Mr. Howson it seems plain that 1946 is none too early for each plant management to appraise its individual requirements and status, in comparison with the general averages used in this straightforward analysis, and start seeking ways and means of meeting this anticipated increase in costs. To this end a 20% upward revision in rates would seem amply justified and based on sound reasoning. [L. H. E.]

A Toast to Health is a Tribute to You

"To Your Health"—still the most popular toast when people get together is a carry over from those days when disease and epidemics would strike suddenly—when good health was enjoyed by the few—and even by them on a temporary lease.

And while "good health" is still an uncertain and evanescent possession, there is little danger of its loss through epidemics or illnesses from water borne bacteria thanks to water works officials. So that every toast to good health is a tribute to your vigilance and skill.

Hooker's part in this maintenance of high health standards is the providing of uniformly high quality Chlorine and the other Hooker chemicals used in water purification and sewage disposal plants. One of the earliest producers of Chlorine, the Hooker Electrochemical Company has continually and consistently supplied chemicals of dependably high purity—to make your work easier and trouble free.

For your continued good health and the good health of the community you serve, continue to specify Hooker Chemicals.

HOOKER ELECTROCHEMICAL COMPANY

Buffalo Ave. and Ward St.
Niagara Falls, New York

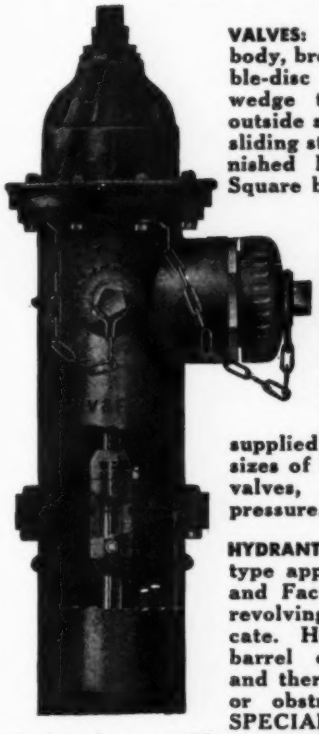
New York, N. Y. Tacoma, Wash.
Wilmington, Calif.

HOOKER CHEMICALS

Ferric Chloride Caustic Soda
Chlorine Muriatic Acid 8515

Dependable! Rugged!

VALVES
HYDRANTS



VALVES: A.W.W.A. type, iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

Hydraulically Operated: For remote control of operation and for quicker, easier opening or closing. Can be supplied in any of the standard sizes of M & H A.W.W.A. gate valves, either high or low pressure.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals. Dry top, revolving head, easy to lubricate. High efficiency because barrel diameter not reduced and there are no working parts or obstructions in waterway. SPECIAL TRAFFIC MODEL is designed to yield at ground line under impact, repair being simply renewal of breakable bolts and breakable coupling on stem.

Write for Catalog No. 34

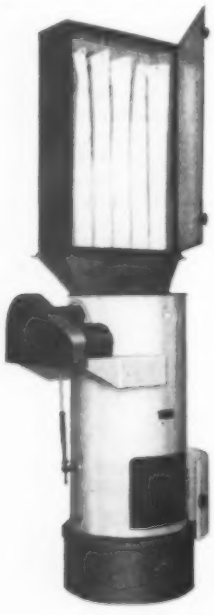
M & H PRODUCTS INCLUDE

FIRE HYDRANTS	SHEAR GATES
GATE VALVES	MUD VALVES
TAPPING VALVES	VALVE BOXES
WALL CASTINGS	FLAP VALVES
SPECIAL CASTINGS	SLUDGE SHOES
TAPPING SLEEVES	FLANGE AND FLARE FITTINGS
CHECK VALVES	FLANGED FITTINGS
FLOOR STANDS	B & S FITTINGS
EXTENSION STEMS	CUTTING-IN TEES

M & H VALVE AND FITTINGS COMPANY

ANNISTON, ALABAMA

Dust clouds in your plant stifle your workers and make equipment look unsightly. Install Omega Chemical Feeders equipped with Omega Dust Removers, designed for efficient dust-proof feeding. Dusty air is drawn through filter bags and collected dust falls into the feed hopper below—without waste.



The Omega Universal Feeder shown with dust remover is a rugged, dependable volumetric feeder. It handles lumps or powder without clogging . . . feeds Alum, Ferrisul, Ferrifloc, lime, soda ash, clay, carbon, etc. Feeding rate is easily adjusted. Write for latest bulletins.

OTHER OMEGA PRODUCTS

Gravimetric Feeders — Lime Slaking Equipment
Solution Feeders — Bucket Elevators
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OMEGA MACHINE COMPANY

(Division of Builders Iron Foundry)

10 Codding St., Providence 1, R. I.

MEETINGS SCHEDULED:

June 5-7—GAINESVILLE, FLA. (University Campus)
Short Course on Water & Sewage Treatment. Dir., Dr. A. P. Black, Prof. of Chemistry, Univ. of Florida, Gainesville, Fla.

June 9-11—MONTEREY, CALIF.
California Sewage Association. Sec'y-Treas., Harold H. Jeffrey, 112 City Hall, Sacramento 14, Calif.

June 13-14—LAFAYETTE, IND. (Purdue University)
Central States Sewage Works Assn. Sec'y-Treas., J. G. Mackin, Route 4, Madison, Wis.

June 19—MANCHESTER, VT. (Equinox House)
New England Water Works Association. (Annual Outing). Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass.

June 20-21—AKRON, O. (Mayflower Hotel)
Ohio Conference on Sewage Treatment. Sec'y-Treas., L. B. Barnes, 441 So. Prospect St., Bowling Green, Ohio.

June 28—LITTLE FALLS, N. J.
New Jersey Section A.W.W.A. (Summer meeting) Sec'y, C. B. Tygert, Box 178, Newark, N. J.

July 18-20—BATON ROUGE, LA. (Louisiana State Univ.)
Ninth Annual Water & Sewage Short Course. Director, John H. O'Neill, Div. of Public Health Eng., P.O. Box 630, New Orleans 7, La.

Aug. 26-28—STATE COLLEGE, PENNA. (Nittany Lion Inn)
Pennsylvania Water Works Operators' Association. Sec'y-Treas., I. M. Glace, 1001 North Front St., Harrisburg, Pa.

Aug. 28-30—STATE COLLEGE, PENNA. (Nittany Lion Inn)
Pennsylvania Sewage Works Assn. Sec'y-Treas., Bernard S. Bush, Penn. Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 9-11—SAVANNAH, GA. (DeSoto Hotel)
Southeastern Section A.W.W.A. Sec'y, B. P. Rice, Healey Bldg., Atlanta 3, Ga.

Sept. 12-13—SANTA FE, N. MEX. (La Fonda Hotel)
Rocky Mountain Section A.W.W.A. Sec'y-Treas., O. J. Ripple, Supt. of Filtration, R.F.D. 2, Littleton, Colo.

Sept. 12-13—PITTSBURGH, PA. (Hotel Roosevelt)
Western Penna. Section A.W.W.A. Sec'y-Treas., E. P. Johnson, 418 Flannery Bldg., Sta. 13, Pittsburgh, Pa.

Sept. 17-20—POLAND SPRING, ME. (Poland Spring House)
New England Water Works Assn. (Annual Meeting). Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass. (On Sept. 16, a pre-convention get-together will be held in the evening.)

Sept. 18-20—TRAVERSE CITY, MICH. (Park Place Hotel)
Michigan Section A.W.W.A. and Conference on Water Purification. (Joint Conference). Sec'y-Treas., R. J. Faust, Michigan Dept. of Health, Lansing, Mich.

Sept. 22-25—FORT WORTH, TEXAS. (Hotel Texas)
American Public Works Congress. Exec.-Dir., Norman Hebden, 1313 East 60th St., Chicago 37, Ill.

Sept. 23-25—
California Section A.W.W.A. Sec'y-Treas., Ray L. Derby, Box 3669 Terminal Annex, Los Angeles 54, Calif.

Sept. 27-28—
Four States Section A.W.W.A. Sec'y-Treas., H. Lloyd Nelson, 1624 Lincoln-Liberty Bldg., Philadelphia 7, Pa.

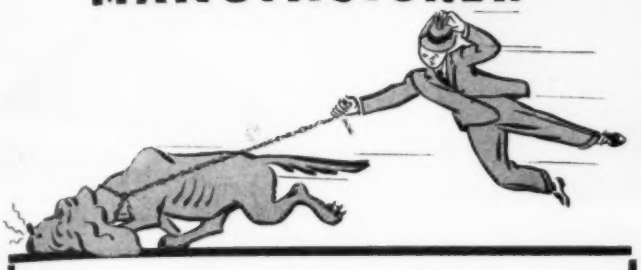
Oct. 3-4—
New York Section A.W.W.A. Sec'y-Treas., R. K. Blanchard, 50 West 50th Street, New York, N. Y.

Oct. 7-9—TORONTO, CANADA (Royal York Hotel)
Federation of Sewage Works Assns. Exec.-Sec'y, W. H. Wisely, 625 Illinois Bldg., Champaign, Ill.

Canadian Institue of Sewage & Sanitation. Sec'y-Treas., Dr. A. E. Berry, Parliament Bldgs., Toronto, Ont.

(Continued on Page 89)

TRACKS DOWN WATER WASTE FOR NATIONALLY KNOWN MANUFACTURER

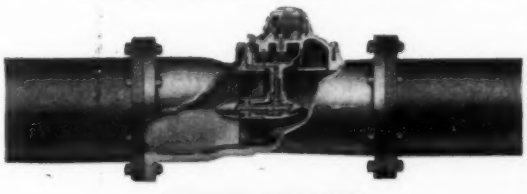


A large manufacturing plant never knew how much water it wasted until a Builders Propeloflo Meter was recently installed. The 8" line, previously unmetered, supplied water at 70 lbs. per sq. in. for continuous blowdown, cooling heat exchangers, washing down the boilers, cooling the bearings of coal feeders, etc. When this Propeloflo Meter showed that an excessive amount of water was being used . . . between 7 and 8 million lbs. of water per 24 hrs. . . . a new boiler room routine was adopted which effected large savings.

The Propeloflo Meter tracks down waste and is successfully used for metering lines carrying hot or cold water . . . as well as other free-flowing liquids such as clear effluent from sewage and trade waste treatment plants. Its streamline Venturi design creates uniform velocity distribution and gives exceptional accuracy through a wide range of flow with low loss of head. The Propeloflo is complete in itself and easily installed in any pipe. For Bulletin 350A, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 10 Codding Street, Providence 1, R. I.

Auxiliary Equipment and Secondary Instruments

Cable Operated Totalizer, Indicator, Recorder
Cable Operated Totalizer
Electrically Operated Totalizer, Indicator, Recorder
Electrical Contact for Batch Control
Treet-O-Control for Chemical Proportioning
Solid extension for counter where meter must be located below floor or ground level.



BUILDERS PRODUCTS

Venturi, Propeloflo and Orifice Meters • Type M and Flo-Watch Instruments • Filter Controllers and Gauges • Master Controllers • Kennison Nozzles • Chronoflo Telemeters • Conveyor Scales.

BEFORE YOU BUY ANY FLOW METER, CHECK WITH BUILDERS.

BUILDERS-PROVIDENCE

BUILDERS

HERE'S THE FLOW RATE CHART THAT'S REALLY *Easy to read*

GET THE WHOLE STORY AT A GLANCE!

Why worry with factors and "microscopic" low rate readings when all Simplex MS meters use an evenly spaced chart—with even graduations from 0 to maximum.

WHAT DOES THIS MEAN TO YOU?

1—The direct reading chart with 0 factor only assures the same high accuracy and ease of reading anywhere in the flow range from minimum to maximum flow.

2—Even graduations make it easy to read low as well as high flows from a distance.

3—Greater accuracy of chart readings from planimeter.

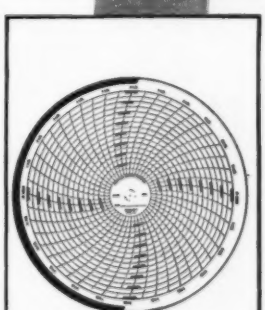
4—Extreme accuracy of chart record is inevitable since pen arm connects directly with bell-shaped float.

5—Special moisture proof paper eliminates stretching and shrinkage—chart cannot slip in use.

Simplex has "engineered" the chart on the MS meter as well as every mechanical detail. This direct reading chart is made possible because of the unique bell-shaped float which extracts the square root of the law of flow. Here is accuracy, ease of recording, and ease of reading—yours for the using in every Simplex Type MS meter. There is no finer meter at the price. Specify Simplex MS meters. Write for details today.

SIMPLEX VALVE & METER CO.
6743 UPLAND STREET, PHILA., PA.

MS meters can be set up as indicator; recorder; indicator and recorder; indicator and totalizor; recorder and totalizor; or indicator, recorder, or totalizor.



12" circular chart for daily or weekly removal. Electric or mechanical clock drive.

SIMPLEX METERS
THE METER WITH THE BELL SHAPED FLOAT

"VIC" VICTAULIC SAYS...

"Where fluids flow, get FULL flow with Victaulic Full-Flow Fittings."

"When you buy a fitting to handle a fluid in your line, you want a fitting that moves it quickly and easily. Many conventional fittings have short, sharp turns and internal projections which slow down flow and increase pumping costs.

"But with any of the complete line of Victaulic Full-Flow Fittings you're sure of wide, smooth, sweeping turns, without internal projections and pockets... fittings that can be swiveled and set at any angle through 360°... can be independently removed from the line. Fittings that will *increase your delivery with lower pumping costs.*

"Adopt a complete Victaulic piping system with Victaulic Full-Flow Fittings and Couplings. They can save you money by increasing efficiency."

Write for new Victaulic Catalog and Engineering Manual

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Have you considered Victaulic for your piping requirements?

Sizes—¾" through 60"

SELF-ALIGNING PIPE COUPLINGS

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EFFICIENT FULL-FLOW FITTINGS

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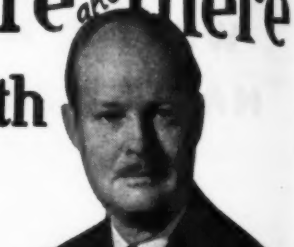
Here and There with Doc Symons



Read and Learn: So said the note from Sam (II) Newkirk, enclosing the following:

"How to Vitalize Drinking Water. Different colors throw off varying vibrations of energy. This is a proved scientific fact. Green throws off the odic ray which is two reverse circles and two reverse straight lines. That is the reason to use green drinking glasses so as to impregnate the water or liquids therein with the mysterious odic ray which issues from leaves, grass and color green.

"From the eyes, finger tips and nostrils issue a stream of vital forces supposed to be thrown off by the pituitary gland. The actuality of these emanations is admitted by accredited scientists. If you desire to impregnate water with these vital forces proceed as follows.

"Place the bunched fingers of both hands about one inch above the water in glass or cup and hold fingers in that position from 2 to 4 minutes. It is essential that the arms are extended downward full length during the charging process. The energies from the pituitary gland seek the shortest path to the earth and will leave through the elbows if the hands are not held downward.

"After the water is successfully charged with the pituitary energy it is no longer plain water; it is far more, it is water plus the dynamic energy injected into it during the charging process from the finger tips.

"I am sure you will greatly benefit in health from the daily drinking of a glassful of this energized water. It costs nothing to prepare save the time involved. It is especially beneficial for children. Milk or any other beverage may be profitably energized in this finger manner. Always be watchful the fingers never contact the liquid in glass or cup.—From

New-design equipment for removing water hardness . . .

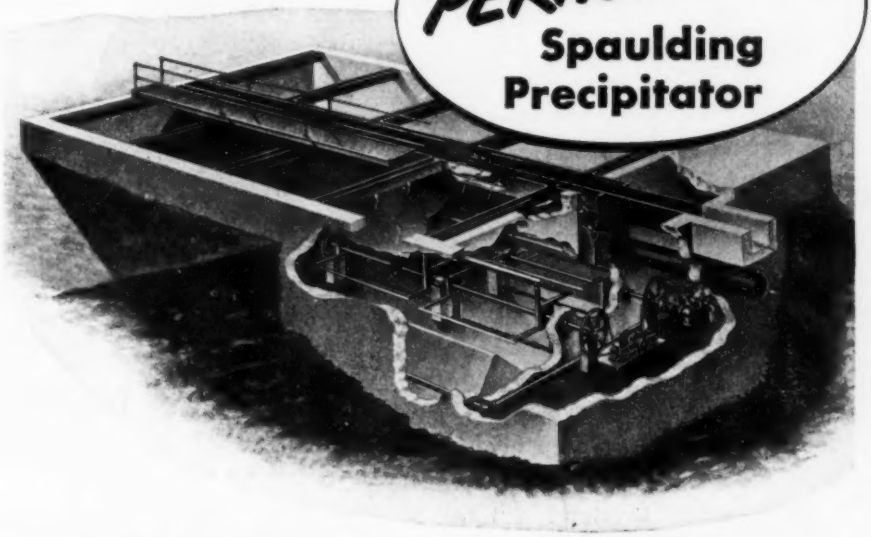
Cuts detention time, saves chemicals, takes only ½ the space of former methods

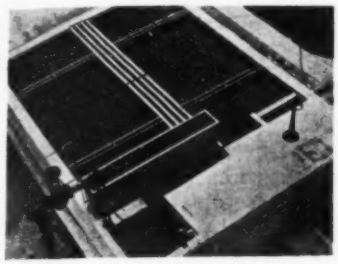
It removes water hardness, dirt and color by the sludge blanket process, cutting detention time and saving chemicals. It requires only half the space of former methods. No wonder engineers, in blueprinting their water improvement plans, specify the Permutit* Spaulding Precipitator.

If YOUR postwar program includes water conditioning—and it should—write for details of this modern, efficient equipment. Address The Permutit Co., Dept. M5, 330 West 42nd Street, New York 18, N. Y., or Permutit Co. of Canada, Lt., Montreal.

*Trademark Reg. U. S. Pat. Off.

PERMUTIT Spaulding Precipitator





PERMUTIT SPAULDING PRECIPITATOR removes water hardness, dirt and color by the sludge blanket process. This new-design equipment cuts detention time, saves chemicals, takes only half the space of former methods. Present installations handle up to 120,000,000 gallons daily.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

to serve you better . . .

WHEN orders outrun production, there are only two ways out; to turn down orders, or to increase production facilities.

Because we chose the latter alternative we had to buy or erect additional buildings, increase and modernize equipment, streamline the whole layout.

We are proud of our increased ability to serve you, old customers and new. If your travels ever bring you within hailing distance of Erie, let us show you the plant that is turning out the famous old Hays line of Water Service Goods with the same old quality and in far greater amounts of our best prewar records.

37 YEARS REMARKABLE SERVICE

HAYS

COPPER · BRASS · LEAD · IRON

WATER WORKS PRODUCTS

HAYS MANUFACTURING CO., ERIE, PA.

5 DIFFICULT JOBS
on a 1500-mile overland trip

and this MORRIS Hydraulic-Cutter DREDGE will shortly move again . . .

Transported overland a total of more than 1500 miles—from Chicago to Roslyn Lake at the foot of Mt. Hood, Oregon—this Morris Dredge has demonstrated over and over again its mobility, maneuverability, and ability to handle a wide range of difficult deposits through long discharge lines and against high heads. It has:

1. Been assembled, dismantled and moved overland four different times; part of the way by trucks.

2. Worked on five difficult deposits.

3. Been quickly and easily reassembled merely by bolting up the compact four-section hull, and the light weight deck house panel sections.

An electrically operated, hydraulic-cutter dredge with a Morris 12" Heavy Duty Dredge Pump, the Captain George is a type of Morris dredge that will handle the most stubborn deposits. Designed for mobility, flexibility and ease of maneuvering, it is especially suited to reservoir cleaning, filling low lands, draining low areas, park beautification and general municipal projects.

Write for
SPECIAL BULLETIN 177
containing descriptions, specifications, and recommendations on Morris hydraulic dredging plants.

THE LOG OF THE CAPTAIN GEORGE

Built in 1930 for heavy sand and gravel production at Chicago, where it delivered through 1500' of 12" pipe against a 30' static head.

Dismantled, moved overland and assembled at Alton, Illinois, for general dredging work on the Mississippi.

Towed upstream for construction work on a Mississippi dam at Dubuque, Ia.

Dismantled, moved overland and assembled at Albert Lea, Minnesota, where it pumped more than 1,000,000 cu. yds. of mud, clay, sand and gravel through discharge lines up to 3500' in length.

Dismantled and moved by train to Portland, Oregon.

Cut apart and moved by trucks from Portland to Roslyn Lake in the Cascade Mountains.

Will shortly be dismantled for another move by truck to a forebay lake on the Clackamas River.

MORRIS MACHINE WORKS Baldwinsville, N. Y.
Sales Offices in Principal Cities

MORRIS CENTRIFUGAL PUMPS

'Thirty Great Secrets for Maintaining Health and Youth,' by Thomas Gaines."

Thanks for the information, Sam; does it work on the elixir of the grape, too?

* * *

Public Relations: Right now there's a lot being said about public relations, and the following contribution to this column seems particularly appropriate on the subject.

REMEMBER THE WATER WORKS MAN

"Give me a glass of water,"
Said the man in a booth nearby;
And I pondered as I listened
To this oft-repeated cry
Just a glass of sparkling water
From the waitress pert and sweet
But a most important item
With the food that we must eat.

Have you ever turned a faucet
Just to watch the water run?
Or watched children sail boats
In the bath tub, just for fun?
Sure you have and I will wager
Any amount you care to pay
You don't know how it got there
On this or *any* day.

Well, it's quite a lengthy story
And right now it should be said
That the plant that treats the water
Works while most folks are a'bed
From the wells and lakes and rivers
To the faucet in your home
Is a lengthy bit of travel
For this H-Two-O to roam.

It is treated and is guided
Thru a maze of pipes and tanks.
To the man that is responsible—
Do you ever give him thanks?
It's his duty and a proud one
To produce this drink so clear
But the praise for all his efforts
One will *very* seldom hear.

His work extends around the clock
Each day you may be sure,
He must be there in your behalf
To keep the water pure.
He tests the water every hour
There are standards it must pass
To be certain when it reaches town
There's safety in your glass.

Tomorrow, sir, when you arise
And to your kitchen go
And see the sparkle in your glass
Of water pure as snow,
Just drink to him who labors long
That in the cup no danger lurks,
Who spends his days and nights
"Sittin' up with the Water Works."

—*Contributed by G. E. Messersmith, Decatur, Illinois.*

STUART-CARTER

CARTER

FLOCCULATION

Write for Bulletin "FLOCER"

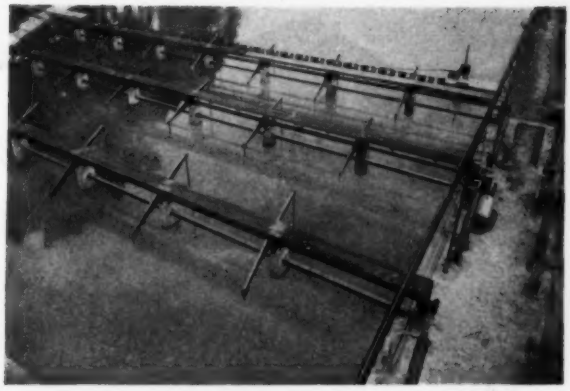


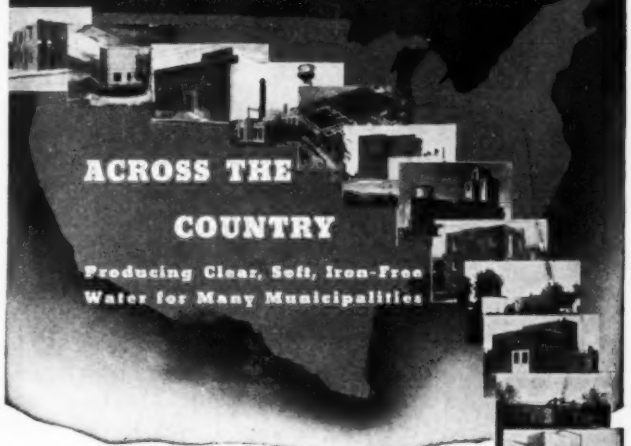
Illustration above shows STUART-CARTER mechanisms in operation at the Moores Bridges Water Purification Plant, City of Norfolk, Virginia.

Heralded as one of the most important developments in the sanitary field, the STUART-CARTER walking beam flocculator mechanism guarantees under the most severe field tests, production of large floc with improved settling characteristics, and equal treatment of ALL water or sewage passing thru the flocculation tank.

Construction features of these units, designed with no moving parts under water, include adjustability of agitating vanes and variable speed hydraulic drive. Drop us a line for complete details . . . no obligation, of course.

RALPH B. CARTER CO.
HACKENSACK NEW JERSEY
NEW YORK OFFICE: 53 PARK PLACE, NEW YORK 7, N. Y.

THERE'S A STRING OF THEM NOW



ACCELATORS are doing a lot of different things for a lot of different kinds of water . . . clarifying . . . softening . . . stabilizing . . . removing color . . . taking out iron.

Results are always excellent . . . frequently remarkable.

You can't beat ACCELATORS for Performance and Economy. Would you like Bulletin 1824?

INFILCO
INCORPORATED
325 W. 25th PLACE, CHICAGO 16, ILL.

Yes, indeed—"Okay! She's through"—is the word-picture of the fast-moving *Hydrauger* performance. *Hydrauger* bores-open-hole for underground pipe installations almost as easily as a hot knife goes through butter. The finished *Hydrauger* bore is clean, and straight and just over pipe size; all of which not only simplifies pipe installation but also avoids disturbing the natural compaction of the surrounding soil. Coated, wrapped, or bell-and-spigot pipe eases through open *Hydrauger* hole without forcing or damage.

The **Hydrauger** operates on 90-pounds air pressure, and uses sufficient water to flush back cuttings from the bit and to "mud" the hole against sloughing. New hi-powered models bore 2½ to 14½ inch holes **fast.** Write for engineering data and illustrated booklet today

HYDRAUGER
HYDRAUGER CORPORATION, LTD.
116 NEW MONTGOMERY STREET
SAN FRANCISCO, CALIFORNIA

Meet Summertime Needs Easily

Are you ready to meet the higher water demand this summer? An N-Sol Process can help you at peak flow. Rates 25% above nominal capacity are frequently obtained with high quality.

This is possible because N-Sol insures faster floc formation and a heavier, tougher floc. Now is the time to look into the use of the N-Sol Process to step up your capacity. Samples of activated silica sols for jar tests furnished free on request.

These processes fit any coagulating procedure:

N-Sol-A*—N Brand Silicate reacted with ammonium sulfate. Used where chloramine sterilization is desired.

N-Sol-B—N Brand reacted with alum. Used with any sterilization procedure. (U.S. Pat. 2,310,009)

Baylis Sol — N Brand Silicate reacted with sulphuric acid. Used with any sterilization procedure. (U.S. Pat. 2,217,466)

*Patent Applied For

N-SOL PROCESSES FOR WATER COAGULATION

DEVELOPED AND PATENTED BY
PHILADELPHIA QUARTZ COMPANY, PHILADELPHIA 6
AVAILABLE UNDER LICENSE WITHOUT CHARGE

Wonder if the spirit of that native son, W. Homer Wisely, could have had anything to do with the city of Coulterville, Ill., making plans for $75,000 worth of sewers and treatment plant.—Wonder if native son Harry Jordan has looked into the matter of the water supply, too.

* * *

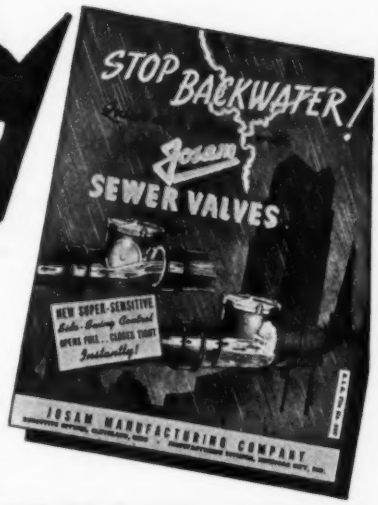
First Winner of the Indiana Section Golden Mittens Award

At the 38th Annual Meeting of the Indiana Sect. AWWA, the first "Golden Mittens" Tournament was held between a group of "Experts" (ordinary folks away from home) and a group of "Local Talent." In the former classification were L. N. Thompson (St. Paul), L. J. Murphy (Chicago), George E. Symons (New York), T. P. Pendleton (Washington), Thos. F. Wolfe (Chicago), N. S. Chamberlin (Newark) and J. R. Brown (Chicago). The Local Boys included Paul Laux (Anderson), E. F. Kinney (Indianapolis), Leo Louis (Indianapolis), H. W. Niemeyer (Indianapolis), H. J. Draves (Michigan City). Referee was M. H. Schwartz; Timekeeper, Jack Gordon, Score Keeper, W. E. Howland; and the judges were Hayes Kuhns, L. F. Lessard, Lou Cantrell, and Fred Bruhn.

After the "Experts" and "Local Talent" had attempted to answer questions from the ringside, the judges made their decision, and John L. Ford, Ford Meter Box (plug) made the award with the following citation:

"In a Golden Gloves Boxing Contest it is fitting that the award be something to wear on the hands. The quality or faculty required for the winning of the Golden Mitten Award is essentially of the mind and so your

GET THIS FREE



LATEST INFORMATION ON HOW TO

PREVENT DAMAGE FROM Backwater in Sewers

The homes, factories, stores and buildings in your community can be easily protected from backwater from sewers. The damage caused by water backing up from street sewers into basements through drains and plumbing fixtures can be positively prevented by the installation of Josam Side Swing Sewer Valves. Waterworks and sewage officials and maintenance men should have the latest information on this subject, and be able to make authoritative recommendations. The literature illustrated gives you a complete understanding of this troublesome problem and how to solve it properly. It's free — write for it today!

JOSAM MANUFACTURING CO., 320 Empire Bldg. • Cleveland 14, Ohio

JOSAM-PACIFIC CO. • EMPIRE BRASS CO., LTD.
SAN FRANCISCO, CALIFORNIA — LONDON, ONTARIO, CANADA
West Coast Distributors — *Canadian Distributors*

THERE ARE NO SUBSTITUTES FOR JOSAM PRODUCTS

RUST & BITUMINOUS ENAMEL CORROSION

There is only one means of permanent protection against the inroads of oxidation — that's *Bituminous Enamel*

We are nationally known approved Applicators of Bituminous Coatings for treating Steel Standpipes, Elevated Water Tanks, Water Mains, Penstocks, Lockgates and other Water Works installations.

IN CASES REQUIRING CATHODIC PROTECTION, WE RECOMMEND BITUMINOUS COATINGS TO ELIMINATE CORROSION AT WATER LEVELS AND ABOVE.

SEND FOR FREE BOOKLET

W. A. BRIGGS BITUMEN Co.
3303 Richmond Street,
PHILA. 34, PA.

Thread pipe faster, with less bother, with these smart, handy, little

RIGID RATCHET THREADERS Nos. 00R and 111R

• With one of these efficient and tough little steel-and-malleable threaders at hand, pipe from ⅛" to 1¼" is quickly perfectly threaded. Die heads with heat-treated tool-steel chasers snap in from either side, can't fall out. No special dies are needed for close-to-wall threads. Smooth internal ratchet. No. 00R, ⅛" to 1"; No. 111R, ⅛" to 1¼." Handy, fast, durable — try one and you understand their growing popularity. Ask your Supply House.

Free handy carrier for any group of sizes.

RIGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

committee has deemed it proper that this prize fit the noble dome of the winner. It is my distinct privilege to present this Golden Mitten Award to this distinguished visitor who so richly deserves such recognition,—George E. 'Doc' Symons.

"May I say a few words about the symbolism of the Golden Mitten and the rich trimmings you observe on it. The Mitten itself is not intended to make you hot headed but rather to help your brain hatch out new ideas. The bulb represents the Lights of Learning which you should continue to shed as you go on through life.

"The fish rampant is not intended to suggest that you are a poor fish. Close observation discloses that this fish is a carp, which was nature's first water purifier.

"The red flower is symbolic of the ardor with which you should always pursue knowledge and pass it on to your fellow men. The blue flower represents Truth to which you should cling at all times,—within reason, that is. The white flower stands for Purity and the fact that it is a little yellow, symbolizes nothing. The significance of the bow of toilet tissue I leave to your imagination.

"May I remind you that this is a momentous occasion. Careful research indicates that this is the first time in all history that the Golden Mitten has been awarded. May you always wear it with pleasure to yourself and honor to Our Association." P.S.—Thanks, Chum!

Peerless
Vertical Centrifugal
Pumps
FOR SHALLOW LIFTS

PEERLESS PUMPS

100 to 5000 g. p. m.
15 to 100 foot head

● Peerless Vertical Centrifugal Pumps are intended for general pumping purposes.

They are built in both the Close-Coupled and Submerged types. The Submerged type is furnished with either top or bottom suction. Direct connected electric motor, steam turbine or engine drive, either direct or through right angle gear.

These pumps are successfully applied to sumps or drainage or wherever it is necessary to move large quantities of water at comparatively low lift.

Installation space is reduced to a minimum, of paramount importance in industrial installations.

Peerless Horizontal Pumps

General service horizontal centrifugal pump arranged for engine drive. Sizes: 8" to 20". Capacities: to 60,000 g. p. m. Heads: to 750 lbs.

PEERLESS PUMPS

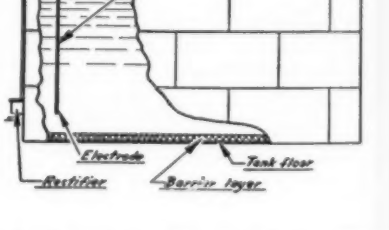
PEERLESS PUMP DIVISION
Food Machinery Corp.

FACTORIES
LOS ANGELES 31, CALIFORNIA
301 West Avenue Twenty-six
QUINCY, ILL. ★ CANTON 6, OHIO

MANUFACTURERS' and EQUIPMENT NEWS

Lime Barrier Supplement to Cathodic Protection Reduces Costs

Electro Rust-Proofing Corp. of Dayton, Ohio, announce the adaptation of what is termed the "Lime Barrier," as a decided adjunct to the cathodic protection process and covering which patents have been applied for.



Application of Barrier Layer With Cathodic Protection.

The "Lime Barrier" consists of the inexpensive use of granular calcium carbonate, such as crushed marble or a good grade of limestone, as a protective floor covering for steel tank bottoms which are flat or have a slope on which the "carpet" of protective carbonate will lie without slipping or being dislodged by the inflowing water.

The "barrier" serves as a protective layer, due to the fact the water next to the metal will be saturated with calcium carbonate. The effect

is that of a cement lining without the objectionable caustic or free lime which new cement always contains until changed to carbonate of lime in time—in effect to limestone. Also the "barrier" is of the same chemically as is the film deposited on steel tank walls when cathodic protection is applied to waters containing a reasonable quantity of calcium.

There should be practically no hardness increase of the water as the result of the "Lime Barrier," because the water within the "barrier" will in itself become only 15 parts harder, if that, and also because there is little or no diffusion or displacement of the water lying next to the metal and within the voids between the granules or chips of carbonate.

The technical role of the "Lime Barrier" is as outlined. The economic role is equally interesting, if not more so. To protect the floors and those areas of metal tanks where the floor and side-walls join has been the costliest part of the cathodic protection system—both from the standpoint of providing effective anode distribution and the additional quantity of current required for these zones in which corrosion supression is so important.

Once a man said that either a Cadillac or a Ford would take him to where he wanted to go, but the cost was about 10 against 1; so, he chose the Ford and had the difference to spend for other things. This "Lime Barrier" scheme in combination with electro-protection, as against 100% cathodic protection, strikes us as representing a similar instance of getting more for ones money—and, also, getting it in a most practical and common-sense manner.

With use of the "Lime Barrier" in one or another form of application, together with the cathodic process as a combination process, it strikes us that the electrolytic method has gained a lot of ground as a practical —economical measure of corrosion control.

For descriptive literature, write Electro Rustproofing Corp., Dayton 10, Ohio.

Stuart Brumley to Distribute Automatic Water Sampler

Announcement has been received that the Stuart Brumley Corp. of Baltimore, Md., will henceforth be the distributor for the Automatic Water Sampler manufactured by the Economy Manufacturing Co. of Chattanooga. This automatic water sampler collects water continuously and makes 12 two-hour composites each day. It was invented by C. B. Swearingen, chemist for the Chattanooga Water Works in 1941, and has been subjected to trial and revision in the years since.

With the appearance of a streamlined refrigerator, the apparatus may be used with ice or mechanical refrigeration. The essential part of the sampler, besides its provision for refrigeration of the sample after collection, is the collection device itself. This consists of a turntable containing 12 sterilized sample bottles, each of which, in turn, comes under the outlet which delivers a small portion of the water supply line every few seconds. It is possible to collect samples not only over a two-hour period, but also during every two-hour period of the day, or the collection may be made for four or six-hour periods.

Further information on the automatic water sampler may be obtained from the Stuart Brumley Corp., Baltimore, Md., or the Economy Manufacturing Co., P. O. Box 188, Chattanooga 1, Tenn.

IT PAYS TO CUT THIS COUPON

Here's a coupon with top value for the holder—*your gas holder.*

From it you'll get *positive* information about the internal condition of your wet-seal gas holder—information that will save you money in reduced maintenance and replacement costs. You'll be able to safeguard failures due to corrosion, misalignment or improper lubrication.

The coupon method of internal inspection is only one of the steps in the Stacey Brothers Gas Holder Inspection Service. Based on scientific survey, thorough examination, laboratory tests and engineering study, we'll give you a comprehensive report and specific recommendations to help you insure maximum life for your holder.

Now's the time to let us give you this personalized annual inspection service. Many prominent operators already have entered their contracts with us for the 1946 season . . . and we've served some of them year after year. Their contract renewals are your best assurance of our ability to give you prompt, economical and efficient inspection. May we discuss your requirements with you?

STACEY BROTHERS GAS CONSTRUCTION CO.
One of the Dresser Industries
5535 VINE STREET • CINCINNATI 16, OHIO

Coupons are cut with a special disc-cutter like this. An Archimedean screw holds the cutter in position, clamps the rubber sealing base ring tight against the holder shell, and prevents the coupon from falling into the holder after it is cut.

This and many other features of Stacey Brothers Gas Holder Inspection Service are described in a 16-page illustrated catalog, number I-44 Write us for your copy.

Stacey Brothers TANKS

where it's always Saturday Night

Two turbulent mountain streams meet, roiled up with dirt and algae drained from mountain swamps. A few miles downstream there's a plant requiring thousands of gallons of water daily . . . but water that must be clean and pure. Before this water reaches the plant, it will need a bath.

If clean, pure water is a manufacturing must, or would improve your products, let SOLVAY Liquid Chlorine "wash" your water for you. Water with SOLVAY is germ-free and clean.

Are you having trouble with water? Let SOLVAY experts show you how to give it a regular Saturday night bath, before it gets into your plant. Write to the Solvay Technical Service Dept.

"SPECIFY QUALITY — SPECIFY SOLVAY"

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 Rector Street New York 6, N. Y.

SOLVAY
LIQUID CHLORINE

Bond-O in Ingot Form

Northrop & Co., Inc., 50 Church St., New York City, has announced that BOND-O self-caulking joint compound for cast iron water mains is now being produced in ingot form as well as in powder form. These BOND-O ingots weigh 10 pounds each and are shipped in 50 pound cartons, 5 to a package. The ingot form is the same material as the powder form, but may be of interest to many water works users because of its ease of storing and cleanliness in using.

Pennsalt Names Moffitt West Coast Sales Manager

T. E. Moffitt has been named Sales Manager of the Pennsylvania Salt Manufacturing Co. of Washington, a subsidiary of the Pennsalt Co.

Fred C. Shaneman, President of the Pennsylvania Salt Manufacturing Co. of Washington, and Vice President of the parent company, said Mr. Moffitt will be in charge of all heavy chemical sales activities in the Tacoma, Wash., and Portland, Ore., plants. His headquarters will be in Tacoma.

Mr. Moffitt, a graduate of the Hill School, Pottstown, Pa., and Cornell University, where he majored in chemistry, moved to Seattle, Wash., in 1923 after serving in Naval aviation during the first World War.

Before joining Pennsalt, Mr. Moffitt was Western Sales Mgr. for the Hooker Electrochemical Co. at Tacoma and was recently engaged in special sales development for the Weyerhaeuser Timber Co. at Longview, Wash.

Briggs Bitumen President Great Grandson of Founder

M. C. Swope Made General Mgr.

In a recent reorganization of the long established W. A. Briggs Bitumen Co. of Philadelphia, M. C. Swope was appointed general manager in charge of operations.

M. C. Swope

W. Ronald Briggs

The Briggs Company, suppliers of bituminous protective coatings, and contractors for the complete application of such protection to tanks, standpipes, gates, penstocks, pipes, and other water and sewage works equipment, has a history and background that goes back to Scotland where the original business was established by the great grandfather of the present head of the company —W. Ronald Briggs, president.

Later the company was reorganized in America by another W. Ronald Briggs—son of the founder and grandsire of the now president, believed to be the youngest of the Briggs to become head of this venerable and conservative company.

Northrop Again Making Hydrant Flow Gauge Sets

Northrop & Co. Inc., 50 Church Street, New York City, has announced that it has resumed the manufacture of new and improved

Hydrant Flow Gauge Sets with two different types of attached Pitots, at their plant in Spring Valley, N.Y. These sets are used to determine hydrant discharge measurements and are furnished with properly designed gauges accurate to ½ of 1 per cent.

During the war these sets were not available but now they can be obtained on reasonably short notice. A new circular picturing the different Test Sets will be mailed upon application to the manufacturer.

St. Louis Turbidimeter

Making use of the Tyndall beam effect produced by rays of light striking particles at an angle to the line of vision, the St. Louis Type Turbidimeter is offered by Phipps and Bird for the accurate determination of low turbidities.

The light from an adjustable lamp in a cast aluminum housing with vertical wells for two Nessler tubes, shines through an aperture and strikes the bottoms of the tubes at an oblique angle. Inasmuch as the accuracy of this apparatus is highest below 2.0 ppm., samples with higher turbidity must be diluted with turbidity free water.

With the apparatus are four Nessler tubes, a bottle of turbidity standard (10 ppm.) and a bottle of turbidity free water. This St. Louis Turbidimeter (A82-800) may be obtained from Phipps and Bird, P. O. Box 2-V, Richmond 5, Va.

WHAT A HYDRANT THIS MATHEWS IS!
A MATHEWS HYDRANT is no ordinary hydrant . . . it has been preferred all over the world for more than 75 years. There's the shield operating nut of malleable iron, capping the bronze revolving nut, and protecting it against damage. This shield serves another purpose . . . it excludes rain, snow, dirt . . . assures free, quick operation always. There's the stuffing-box plate, cast integral with the head, keeping the stem threads corrosion- and sand-free. There's the feature of oiling from the outside; nozzles that raise and lower; head that rotates a full circle; low-placed orifice that drains out all the water; main valve opening against, and closing with, water pressure. And there's the famous barrel . . . containing all the working parts including the seat; if it gets damaged you simply draw it out and insert a spare . . . no loss of time . . . no imperiling of the community . . . no breaking of the pavement . . . no excavating. No hydrant compares with a modern Mathews in simplicity, ruggedness, dependability. No wonder there are some 400,000 in use today.
MATHEWS HYDRANTS
Made by R. D. WOOD Company
PUBLIC LEDGER BUILDING
INDEPENDENCE SQUARE, PHILADELPHIA 5, PA.
MANUFACTURERS OF SAND SPUN PIPE (CENTRIFUGALLY CAST IN SAND MOLDS) AND R. D. WOOD GATE VALVES

(*Continued from Page* 78)

Oct. 9—BANGOR, ME.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

Oct. 10-12—COLUMBUS, O. (Hotels Fort Hayes & Chittenden)
Ohio Section A.W.W.A. Sec'y-Treas., F. P. Fischer, 811 Perry Payne Bldg., Cleveland, O.

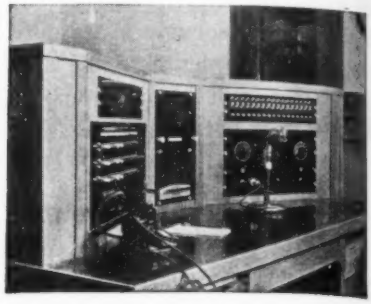
Oct. 14-17—GALVESTON, TEXAS
Southwest Section A.W.W.A. Sec'y-Treas., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 17—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. (Executive Committee Meeting.) Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass.

Electronic Communication Guards West Coast Water Supply

The Wardlow watershed, covering more than 25 acres, is the source of supply for the Long Beach, Calif., city water system. In order to provide means of contacting personnel to operate emergency repair trucks, the city authorities installed a central control communications system which gives complete and immediate amplified voice communication over the entire Wardlow plant area. The system consists of a master station and selector at the central communications desk, two trumpet speakers to cover the outside yard areas and eight substations. The substations are used to contact executives and by the receiving and shipping departments, and one is also installed at each of the guard stations, while others cover the machine shop, garage, call-room, and blacksmith shop.

Manufactured by the Executone, Inc., the Executone Master Station and Selector and the entire system have been found invaluable to the Long Beach water supply. For appearance and accessibility, the Master station and Selector were removed from their original cabinets and placed in the center panel of the specially constructed Communications Desk. It also contains a Western Union clock, a P.B.X. board, and a short wave radio, all virtually at the operator's fingertips.



This communications system permits of immediate contact with persons at remote locations, reduces the time required for crewmen to reach breaks or other repair locations.

Not only is this system of communication useful in water supply areas, such as the Wardlow supply of Long Beach, but it is known that this type of system has been found useful in sewage treatment plants and water plants for communications from the main office to various sections of the plant or laboratory, as the case may be.

Further information on this system may be obtained from Executone Co., Inc., 415 Lexington Ave., New York 17, N. Y.

E. H. Thwaits To Direct Preload Pipe and Lining Dept.

The Preload Corporation of New York has announced the appointment of E. H. Thwaits, consulting engineer, to direct the Prestressed Concrete Pipe and Pipe Lining Department with headquarters at 420 Lexington Ave., New York 17, N. Y.

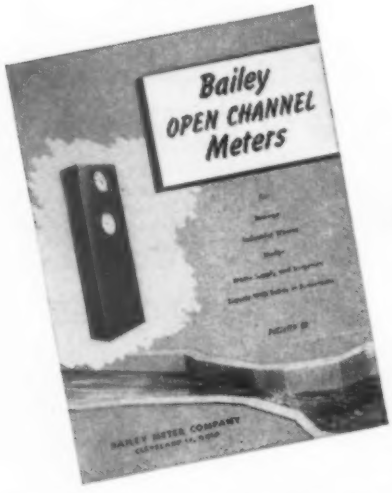
E. H. Thwaits

Mr. Thwaits was formerly re-

THE BAILEY OPEN CHANNEL METER

1. Retains Accuracy
2. Self-Cleaning
3. Easy to Install
4. Easy to Maintain
5. Adjustable Capacity
6. Indicates, Records, Integrates
7. Totalizes Multiple Flows
8. Simple Chemical Feed Control
9. Rate of Flow and Ratio Control

A Reliable Low Cost Meter for



SEWAGE
INDUSTRIAL WASTES
SLUDGE
IRRIGATION WATER

Ask For Bulletin 62

MU23

BAILEY METER COMPANY
1072 IVANHOE ROAD • CLEVELAND 10, OHIO
METERS and CONTROLS for SEWAGE and WATER
VENTURI TUBES, FLUMES, WEIRS, NOZZLES, ORIFICES • DIRECT MECHANICAL AND REMOTELY LOCATED REGISTERS • AIR-OPERATED, ELECTRONIC AND ELECTRIC CONTROLS.

search engineer in charge of pipe for the American Iron & Steel Institute of New York, and consulting engineer in charge of the water pipe department for the Youngstown Sheet and Tube Co., Youngstown, Ohio.

R. N. Oliver Clayton's Southwest Representative

It has been announced that Russel N. Oliver has been promoted to the position of District Manager of

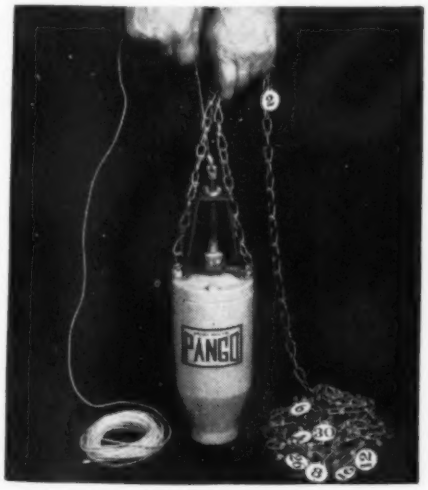
R. N. Oliver

the Clayton Valve Manufacturing Co. in the Southwest area. Having permanent headquarters in Dallas, Texas, he will represent The Clayton Manufacturing Co. in Texas, Oklahoma, Arkansas, Western Tennessee, and Northern Louisiana.

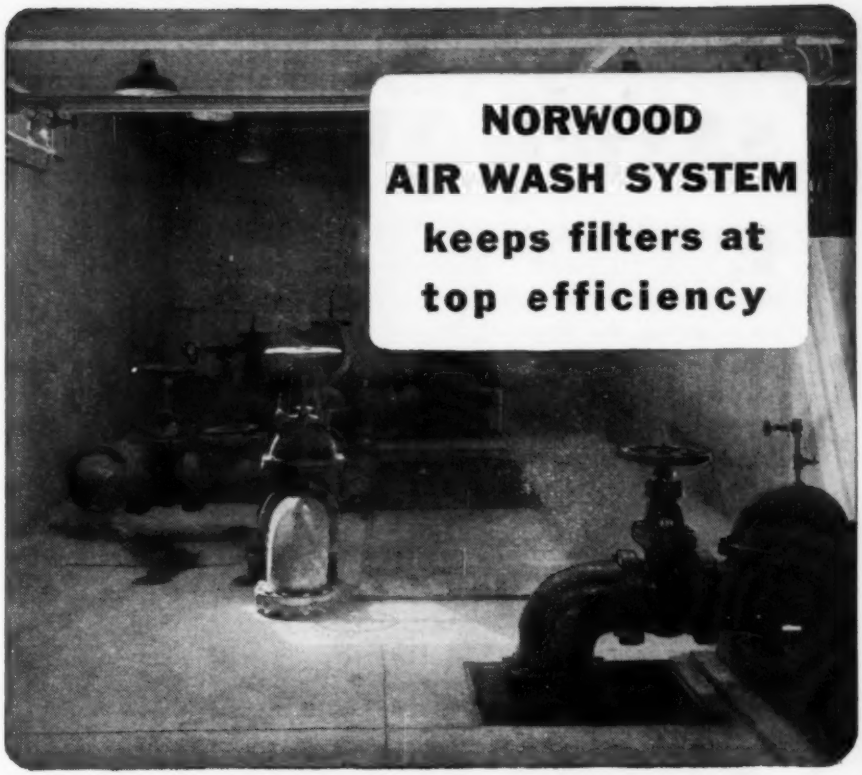
Mr. Oliver, who has had fourteen years' experience in the valve industry, served as Heating and Plumbing Consultant Engineer to the U. S. Army at Port Hueneme, California.

Pango Sewage Sampler

The Pango, "accurate sewage sampler," is now available. As shown in the accompanying pho-



tograph, the device which is not only heavy enough to sink through sludge in digesters has a ball valve at the bottom and a ball valve release at the top, both held in position by a spring. When the sampler is lowered to the desired depth as indicated by the markers on the chain, the valve is raised by means of a cord, the sampler then filling from the bottom with the air escaping from the top, thus preventing any aeration of the sample during its collection. Sampling of lakes or streams could be done with this apparatus, and it is particularly useful in collecting samples at various levels in sedimentation tanks, in sewage conduits, and in sludge digestion tanks. For further information write the Drake Manufacturing Co., 1461 Belefield Avenue, Philadelphia, Penna.



Pumps and Valves for Back-Wash System of Norwood Filters at American Brass Co., Ansonia, Conn.

A filter bed is no more efficient than its back-wash system. Thorough cleaning of the filtering medium is essential if operation is to be trouble-free and water volume is to be maintained at design levels.

Norwood's Air Wash System introduces air into the filter unit through a separate brass manifold system at the top of the supporting bed. In this way the air and wash water are introduced simultaneously and excellent scrubbing action of the sand particles results preventing the formation of mud balls in the bed. The high efficiency of this method permits a reduction of as much as 50% in the consumption of wash water in this system.

Norwood invites inquiries from municipal, consulting or industrial engineers regarding any water treatment problem. W-5

The NORWOOD ENGINEERING COMPANY
25 N. Maple St.
Florence, Mass.

The Best For Your Money
NORWOOD FILTERS
In The Long Run

Improved Electro-Rod

The Spartan Tool Co. of Chicago has announced a new and improved Electro-Rod, a versatile motor driven pipe cleaning machine. Safety and simplicity of operation are stressed in several new features.

Features and advantages of the new design include the ability to disengage the cable without stopping the motor, feeding the cable in and out without stopping motor;

★ THE NATIONAL METHOD • OVER 35 YEARS EXPERIENCE ★

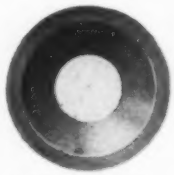
SAVE For VICTORY

★ ★ ★

EVERYWHERE Americans are being asked to "SAVE FOR VICTORY." Water works superintendents, engineers and public officials can do more in this connection by investigating the National Method of water main cleaning. This method restores the carrying capacity of pipe to at least 95 per cent of that of new mains, thereby eliminating the necessity for purchase of new mains. Aside from this the National Method makes possible lower pumping costs, greater delivery, reduced insurance rates and clean water.

Before Cleaning

The NATIONAL METHOD



After Cleaning

GUARANTEED TO RESTORE 95% ORIGINAL CAPACITY

The National Water Main Cleaning Co.

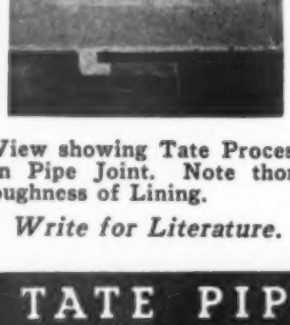
50 Church St. Branches: New York 7

115 Peterboro St., Boston 15, Mass.
P. O. Box 749, Mayaguez, Puerto Rico
7103 Dale Ave., St. Louis 17, Mo.
3707 Madison St., Kansas City 2, Mo.
3812 Castellar St., Omaha 5, Neb.
P. O. Box 683, Jacksonville 1, Fla.
205 West Wacker Dr., Chicago 6, Ill.
501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Can.
576 Wall St., Winnipeg, Can.

The TATE Cement Lining Process

Restores efficiency of old Water Mains

Now is the time to investigate the Tate Cement Lining process —and see what it can do to restore the efficiency of your old water mains.



View showing Tate Process in Pipe Joint. Note thoroughness of Lining.

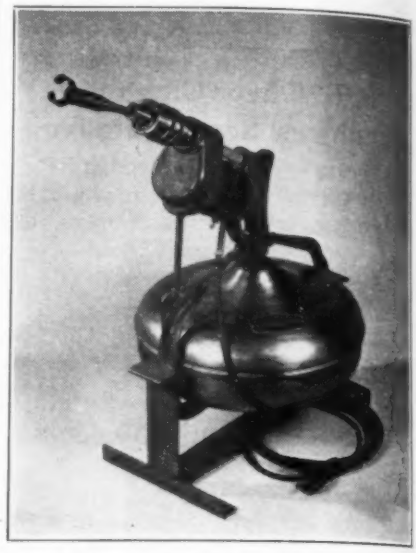
Write for Literature.

What the TATE Process accomplishes

1. Water mains cleaned and cement-lined without removing pipe.
2. Eliminates discoloration and further cleaning costs.
3. Reduces pumping costs.
4. Restores reduction in head and flow co-efficients. This means full fire protection and lowered insurance rates.
5. All joints cement-lined . . . just one continuous pipe.
6. Does the job without interruption of service to consumer.

TATE PIPE LININGS, Inc.
ANDOVER, MASS.

and high torque in the cable. The improved 1946 Electro-Rod is easily operated by one man and is designed to clean clogged lines of from 1 to 4 inch diameter.



A folder is available from the manufacturers, The Spartan Tool Co., Chicago 45, Ill.

Frank Roe Made Eastern Field Manager for Chicago Pump Co.

The Chicago Pump Company has appointed Frank C. Roe Eastern Field Manager of its Sewage Equipment Division with offices in New York City.

Frank C. Roe

Stanley E. Kappe, who at present holds this position, is establishing his own business as Sales Agent, with headquarters in Washington. In this new capacity Mr. Kappe will continue to represent Chicago Pump Co. in sewage works equipment sales and service.

Mr. Roe was graduated in Sanitary Engineering at the University of Illinois in 1925. His first two years out of school were in the service of the Sanitary District of Chicago, after which he was a partner of Shields, Jordan and Roe, Engineers, for five years.

During the last fourteen years, Mr. Roe was with the Carborundum Company, Niagara Falls, New York and Perth Amboy, New Jersey, as development engineer and manager of porous products sales. He was responsible for the development of their porous diffusers for sewage and water aeration, porous under-

ground plates for water filters and numerous other products and applications. He has contributed a number of articles on the application of these porous products to sewage aeration that have been published in various magazines serving the sanitary engineering field.

Mr. Roe is an active member of Central States Sewage Works Association, Canadian Institute of Sewage and Sanitation, and the American Water Works Association.

Beginning about July 1st Mr. Roe will make his headquarters at the New York office of the Chicago Pump Co. at 79 Madison Avenue.

Concrete Pipe Ass'n Reorganizes

38th Annual Convention in Chicago Elects E. L. Johnson President

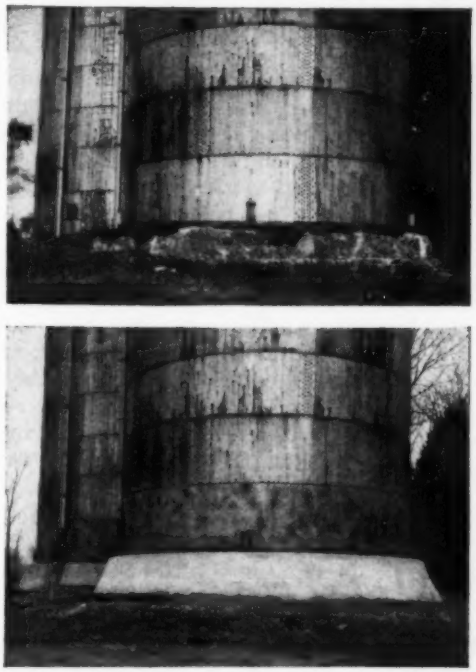
The American Concrete Pipe Association effected a complete reorganization plus a revision of its constitution and by-laws, during its 38th Annual Convention held in Chicago April 11-13. Retiring president,

O. H. Miller & E. L. Johnson
(Retiring and Incoming Presidents)

O. H. Miller, (Cocktaw, Inc., Memphis, Tenn.) explained to members that the reorganization was meant to aid them in regearing for profitable production under normal conditions, and that it was now their duty to attend to this program. He also said that the new and strengthened organization was more in keeping with the size of the industry.

Officially opened on Thursday morning in the Edgewater Beach Hotel, Chicago, the convention was attended by more than 200 persons, representing the industry from coast to coast. During the opening session the recently appointed managing director, Howard F. Peckworth, presented his annual report. He told the group that concrete pipe was used almost exclusively in the construction of Army camps and airfields, with no apparent failures and no reported complaints as to service and durability. In his report he discussed the services of the Associa-

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



"GUNITE" SAVES FOUNDATIONS

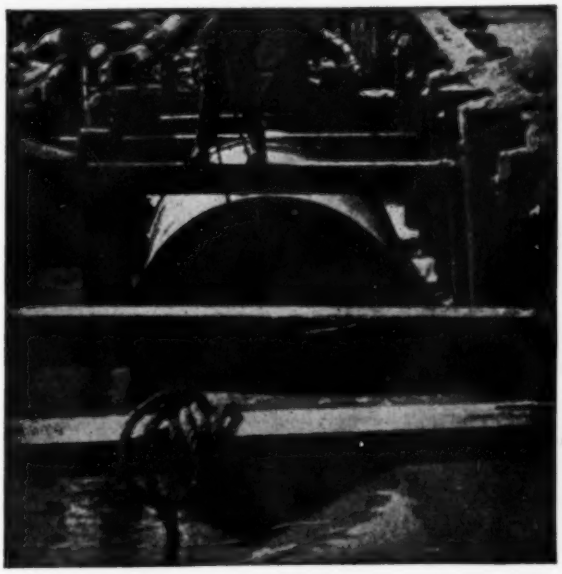
The "before" and "after" photos show two of three water standpipe foundations which we restored two years ago for the Village of Carthage, N. Y.

These foundations were very seriously disintegrated and in dangerous condition. All loose and deteriorated concrete was chipped away and mesh reinforced "GUNITE" placed 3" to 12" thick to restore the foundations to original dimensions. Extreme care was taken to place "GUNITE" well under the bearing edge of the standpipe.

This work was done under the supervision of Mr. J. Lamprecht, Consulting Engineer, Fayetteville, N. Y.

Our 72-page bulletin C 2300 describes scores of uses of "GUNITE". Write for your copy.

MANUFACTURERS OF THE "CEMENT GUN"



84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.

tion which include the development of trade advertising and special promotions, research, and technical services. He reported that the Association, working in conjunction with several universities, had maintained important research projects. The managing director's report closed with a statement oncerning future plans of A. C. P. A.

A highly profitable and popular feature of A. C. P. A.'s program this year was the socalled "Jam Session" in which a panel of experts attempted to give answers to questions which had been submitted by members in advance of the session.

A vote of appreciation was given program chairman E. H. Fox (Cincinnati Concrete Pipe Co.) for the exceptionally fine program and it was voted also to carry on the question-and-answer plan as a regular service of the office of the Managing Director —Howard Peckworth.

To serve as A. C. P. A.'s president for the next year, Elmer L. Johnson, president of the Concrete Conduit Co., Colton, Calif., was elected. The new president has been in concrete pipe industry for the past 14 years, and has previously served as vice-president and member of the board of directors of A. C. P. A.

MR. SUPT:—

Sure! You can superchlorinate and avoid high residual chlorine taste when—

you post-treat with Virginia's "ESOTOO".

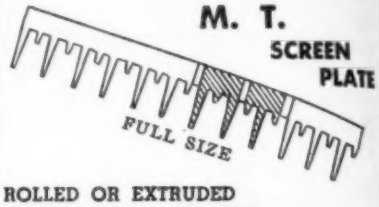
Write us today.

VIRGINIA SMELTING COMPANY
WEST NORFOLK VIRGINIA

FINE SCREENS FOR SEWAGE TREATMENT

ADVANCED DESIGN
AND CONSTRUCTION
COMPLETE INSTALLATIONS

THE NEW M. T. SCREEN PLATE



ROLLED OR EXTRUDED
AT THE MILL IN STAINLESS
STEEL OR "EVERDUR"
HIGHER STRENGTH
HIGHER EFFICIENCY
LOWER COST AND UPKEEP

M. T. SCREENS IN LARGER SIZES FOR WATER FILTER BEDS—NO LARGER SIZES OF GRAVEL OR OTHER FILTER MATERIAL REQUIRED—CLEANING AND BACK-WASHING SIMPLIFIED.

SANEQUIPMENT ENGINEERING
2843 WHITEWOOD AVE.
ANN ARBOR, MICHIGAN

Have you seen?

the PITTSBURGH · EMPIRE COMPOUND

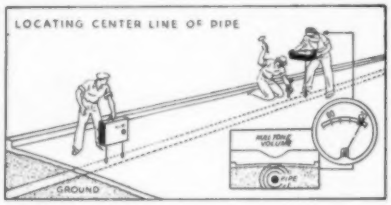
a revolutionary NEW meter with many advantages

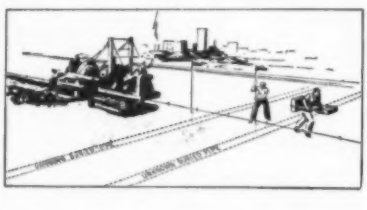
PATENT APPLICATION MADE

.. Ask for Bulletin W-803 ·

Pittsburgh Equitable Meter Division
ROCKWELL MANUFACTURING CO.
Pittsburgh 8, Pa.

M-SCOPE

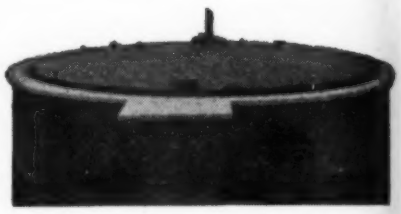




BURIED PIPE AND CABLE FINDER

16 PAGE BOOKLET FREE UPON REQUEST

FISHER RESEARCH LABORATORY
Palo Alto, California



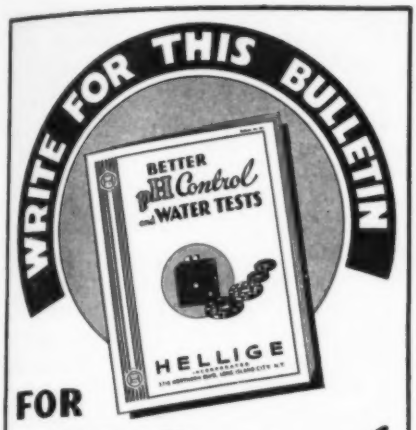
Over 225 P. F. T. Floating Covers in War Service

The health of our fighting men and war workers is being safeguarded by modern sewage disposal plants. We are doing our part by delivering on time P.F.T. Floating Covers and other sewage treatment equipment.

The P.F.T. Floating Cover for single and stage digestion hastens the digestion process, and provides for utilizing the sewage gas to heat water for the digester tank.

Catalog No. 232 contains complete information, including specifications. Write for your copy.

P.F.T. PACIFIC FLUSH-TANK CO.
4241 Ravenswood Ave., Chicago, Ill.
New York Charlotte, N. C.



FOR

pH Control and WATER TESTS

A study of our 28-page Bulletin No. 602, containing the complete line of Hellige apparatus for pH control and water analysis, will enable you to form an intelligent opinion as to what is best suited for extending your present equipment or for an initial installation.

HELLIGE
INCORPORATED
3718 NORTHERN BLVD., LONG ISLAND CITY 1, N.Y.
HEADQUARTERS FOR COLORIMETRIC APPARATUS

LITERATURE AND CATALOGS

Link-Belt's Annual Report

It isn't often that we enthuse over an **Annual Report** from a manufacturing company, but the 1945 Annual Report of the Link-Belt Co. strikes us as being one of the most interesting and informative that we have seen for a long time. Profusely illustrated with pictures of typical installations, the book is in effect a catalog of types of equipment manufactured by the company. But that is only one part of it. One section of it is devoted to a history of the company and its products, very cleverly done with pen and ink sketches showing the growth of the Link-Belt service to the industry. Naturally, the book contains financial statements, which to anyone interested would be quite understandable, but it is the President's report to the stockholders which really takes one's eye, for by means of graphic charts and illustrations it is completely understandable.

Eddy

TAPPING MACHINE
VALVE
TAPPING MACHINE
SLEEVE

FOR branch connections specify the Eddy Tapping Valve and Sleeve. These, when used with drilling or tapping machine, insure a trouble-free, water-tight connection. Iron body bronze mounted, tested to 300 lbs. pressure, recommended for anything up to 150 lbs. pressure.

EDDY FOR LONG SERVICE

EDDY VALVE COMPANY
WATERFORD, NEW YORK

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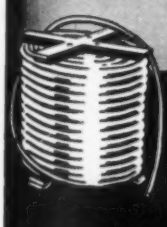
HYDRO-TITE — The self-caulking joint compound that makes cast iron water pipe joints — strong — tight — flexible and everlasting. Used on thousands of miles of pipe with a record of more than 30 years without a failure.

FIBREX — The sanitary paper packing that is used like braided jute. Free from bacteria — treated with a water repellent — put up in 60 pound reels. 70 pounds of Fibrex takes the place of 100 pounds of braided jute.

HYDRAULIC DEVELOPMENT CORPORATION
50 Church St.
New York, N. Y.



DRY BRAIDED
Fibrex

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A.W.W.A.

VOGT BROTHERS MFG. CO. Incorporated
MAIN AT 14th LOUISVILLE, KY.
VOGT
VOGT MFG. CO., Incorporated
P. O. BOX 1122 LOUISVILLE, KY.

AERO-MIX

AERATOR—MIXER

A Size and Type to Fit Your Problem in Water or Sewage Treatment.

WRITE FOR INFORMATION

AMERICAN GAS BOILERS
STEAM AND WATER TYPES
for Digester Heating
FOR RATINGS AND DATA SEE OUR PAGE IN THE 1946 ANNUAL REFERENCE SECTION
American Radiator & Standard Sanitary Corporation, Pittsburgh 30, Pa.
SALES OFFICES IN PRINCIPAL CITIES
AMERICAN-Standard
HEATING PLUMBING
Serving the Nations' Health and Comfort

Leopold
GLAZED FIRE CLAY TILE FILTER BOTTOM
Non-Corrosive—Permanent
DRY CHEMICAL FEEDERS
Accurate—Dependable
also
COMPLETE WATER TREATMENT EQUIPMENT
F. B. LEOPOLD CO., INC.
422 FIRST AVE. PITTSBURGH 19, PA.

for CONCRETE and STEEL!
Inertol
Protection
Means Lowest Cost
Per Year
INERTOL COMPANY, INC. NEWARK 5, NEW JERSEY and SAN FRANCISCO 7, CALIFORNIA

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.
KNOWN AROUND THE WORLD AS THE SIGN OF EXCELLENCE IN WATER TREATMENT EQUIPMENT
The years of experience behind the Roberts nameplate is your assurance that any water rectification problem is expertly handled to your best advantage. As manufacturing and installation engineers, the Roberts organization is equipped to meet your exact needs regardless of the size of the equipment or the complexity of the problem.
GRAVITY FILTERS • SOFTENING PLANTS AND EQUIPMENT • PRESSURE FILTERS ZEOLITE SOFTENERS • SWIMMING POOL RECIRCULATING APPARATUS SPECIAL WATER TREATMENT EQUIPMENT.
We invite your inquiries
ROBERTS FILTER MANUFACTURING COMPANY • Darby, Pa.

From a series of 15 charts one may readily see the growth of the company; the number of employes each year; the distribution of stockholders and of stock holdings; total sales, net profits, wages, salaries; distribution of net sales, and of the sales dollar, as well as current assets, liabilities and net working capital since 1929; a breakdown of the assets provided by the 6,021 owners; what that breakdown means in the terms of each employee; a comparison of the last five years' business to the previous thirty-five years' business; the relation of material and costs, wages and salaries, taxes, and net profit to each other in each year for the last six years, as well as the distribution of taxes per shares of common stock, as well as per dollar of wages and salaries.

One certainly can see from this report the definite inter-relation of capital, management, and labor, and the relation of production to wages, to taxes, and to profits. As with so many industries, the net profit to stockholders is a small percentage compared to wages, taxes and cost of material.

If for no other reason than that this Annual Report has made a report to the stockholders understandable, we can recommend that this book be obtained to see how it is done. Link-Belt's executive office is located at 307 North Michigan Ave., Chicago 1, Ill.

Meter Repair and Testing

"Why Planned Meter Repair?" The answer to this and many other questions on the matter of meter repair is given in the Manual for the Water Meter Shop, titled **Planned Meter Repair and Testing**, issued by the Neptune Meter Company of New York. This little booklet is written to help the smaller water utility in three ways: (1) It tells what is needed to set up a planned meter repair program. (2) It shows how to lay out a meter shop, and (3) its step-by-step repair instructions present many "hints" that will save time, improve accuracy, and reduce waste.

Amply illustrated, this bulletin should do what it was intended to. Without doubt this little booklet, consisting of 16 pages, will be of great interest to any person responsible for the proper operation of a meter repair shop. The booklet may be obtained free of charge by writing to the Neptune Meter Co., 50 West 50th Street, New York 20, N. Y.

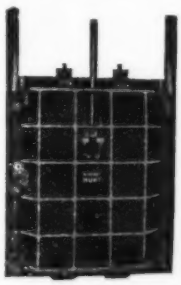
STEEL FORMS
for CONCRETE
METER BOX
TILES

You can make excellent meter box barrels at low cost with one of these steel forms. They are made in several sizes and lengths.

Let your post-war plans include making good use of one or more of these forms. Make a start now by asking for information.

FORD
Meter Box Co.
WABASH, INDIANA

RODNEY HUNT



GATES and HOISTS

Metal or timber sluice gates of all sizes and designs, approved by engineers everywhere. Improved gate stands and hoists for hand or motor operation. Also flap and mud valves, shear and filler gates, trash racks and rakes. Dependable canal equipment from dam to tail-race since 1840.

Write for Special Catalog Today!

RODNEY HUNT

RODNEY HUNT MACHINE CO.
118 Lake St., Orange, Mass., U. S. A.

Sanitation and Process Equipment

In a 44-page book available from Chain Belt Co., titled **Rex Sanitation and Process Equipment** the complete line of Chain Belt equipment is presented. It would be impossible to completely and adequately set forth here all of the information in this new 44-page book, which is profusely illustrated with pictures, drawings, and diagrams. Among the many products shown and described are conveyor sludge collectors, Tow-Bro sludge removers, grit collectors, washers, Verti-Flo thickeners, skimmers, Aero-filters, Floctrol, rapid mixers, gravity waste water-oil separators, and water screens, as well as Tritu rators and other items.

This Bulletin No. 46-3 may be obtained from the Chain Belt Co., 1600 West Bruce Street, Milwaukee 4, Wis.

J-M Products for Water Works

In a two-part, 72-page book, entitled **Products for the Water Works Industry** the Johns-Manville Corp. has presented more than 100 photographs and actual installations of J-M asbestos products in water works systems through the country. If your water plant happens to be one of those pictured, you will find that it is identified and located by name in the caption. Typical of the many applications are installations of piping; water mains; packing of fire hydrants, valves and centrifugal pumps; gasketing for steam lines and re-circulation lines; Asbestos-Ebony for control tables and instrument panels; Transite for reservoir covers, storage sheds; Transite pressure pipe for distribution mains; well casings and screens, and for filter underdrain systems.

The second part of the book is a catalog containing descriptions of the illustrated J-M products with further information regarding their use. Copies of this book may be obtained by writing Johns-Manville, Box 290, New York 16, N. Y., and for brochure No. TR-39A.

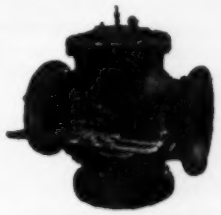
Modern Sewage Treatment

One of the most interesting and informative books yet to come to our desk on the subject of equipment for sewage treatment is the recent issue on **Modern Sewage Treatment** as published by the General Electric Co. of Schenectady.

· 1879 ·
ROSS
AUTOMATIC VALVES

ALTITUDE VALVES • SURGE • RELIEF • BACK PRESSURE VALVES

FLOAT VALVES • REDUCING AND REGULATING VALVES



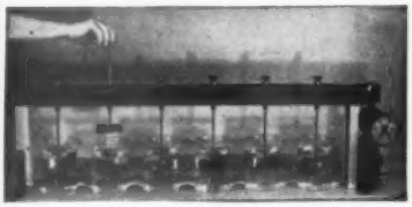
ALTITUDE VALVES
for
Control of elevation and heads into and out of tanks, basins and reservoirs, hydraulic control.
1. Single acting.
2. Double acting.
3. Combination assembly for three or more automatic operations.
4. Can be equipped with electric and manual controls.

COMBINATION VALVE
This valve will permit flow in one or both directions acting as
1. Pressure Reducing and Relief Valve.
2. Pressure Reducing and Altitude Valve.
3. Relief and Altitude Valve.

REMOTE CONTROL VALVE
Electric remote control—solenoid or motor can be furnished.
Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

ROSS VALVE MFG. CO.
INCORPORATED
P. O. BOX 595, TROY, N. Y.

IMPROVED JOINTING COMPOUND
Tegul-
MINERALEAD
for Bell & Spigot Main
• Sulphur base; quick sealing, speeding laying and backfilling.
• 10 lb. ingot form, easily handled, stored and shipped. Impervious to rain. Cannot change composition.
• Makes permanently tight joints. Goes 3 to 5 times as far as lead, helping conserve a strategic war metal.
• For money-saving information, write
The ATLAS MINERAL Products Company of Pa.
Mertztown Pennsylvania

THE Phipps & Bird
LABORATORY MIXER . . .

IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.
PHIPPS & BIRD, INC. Richmond, Va.

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JOINT LEAKAGE
WITH
CARSON CLAMPS
AND MECHANICAL JOINTS
Charcoal iron bolts for Cast Iron Pipe and Fittings.
Write for Prices.
Carson-Cadillac Co.
1221 FINSON ST. BIRMINGHAM, ALA.

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The ORIGINAL and FINEST . . . .

Manhole Cushion U. S. Pat. No. 2,050,050 offers you the simplest solution for noisy, rattling covers. Easy to install. Lasting — Economical.
Write for story of Tapax and Trial Offer.
TAPAX MFG. CO., INC.
MAMARONECK NEW YORK

Written primarily for the lay public to bring to its attention the menace of water pollution to the public health, national resources and recreation, and the means for abating this menace, the book will be found of great interest to engineers and sewage works operators alike.

Not only does the book contain sections on modern sewage treatment and its advantages but it also shows various types of equipment used in sewage treatment works of different design, employing different types of treatment.

Also included in the book is a section on how to bring this problem to the attention of the community. The book is a companion piece to the General Electric motion picture titled "Clean Waters" and the book contains a transcript of the voice script of the movie, as well as valuable hints as to how to either show the movie or how to present the problem and its solution to the public. The book will be of help to sewage works operators in their efforts to develop better public relations.

The latter part of the book is devoted to tables of motors used in sewage works, to estimates of the amount of sewage works construction needed, and to principal electric equipment used in sewage works, as well as definitions of terms used in sewage works practice.

This book which may be obtained by writing the General Electric Co. should be found in the library of every student, operator, and engineer in the field of sewage treatment or public health.

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101 Uses for Wrought Iron

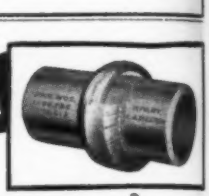
Under the intriguing title of *101 Uses for Wrought Iron*, the A. M. Byers Co. of Pittsburgh, Pa., has issued a brochure that is given over almost entirely to a photographic record of the various uses of wrought iron.

Beginning with floor plates on a railroad bridge and running through ornamental gates, to pipe coils in a soap factory, this 32-page booklet is full of interesting pictures.

Are water and sewage works represented? Well, rather! A thousand ft. wrought iron sewer outfall line at Loch Arbour, N. J.; heating coils in a sewage sludge digestion tank at Peoria; coarse bar screens in a sewage plant in Missouri; storm sewer inlets in Pittsburgh, Pa.; water lines in a swimming pool at North Park, Allegheny County, Pa.; sprinkler

ANTHRAFILT
A Filter Medium For All Purposes
ANTHRACITE EQUIPMENT CORP
101 Park Ave. New York
All correspondence regarding sales and engineering should be addressed to:
PALMER FILTER EQUIPMENT CO.
822 E. 4th St. Erie, Pa
Engineers and Sales Agents

EDSON
DIAPHRAGM PUMPS
Hand Sizes 2", 2½", 3", 4"
Power Sizes 3" and 4"
Open Discharge or Force Pump
Edson Special Suction Hose
Red Seal Diaphragms
Strainers and Foot Valves
Hose Spanners—Adapters
THE EDSON CORPORATION
Main Office and Works: 49 D St.
South Boston, Mass.
New York: 142 Ashland Pl., Brooklyn

WESTON

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12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
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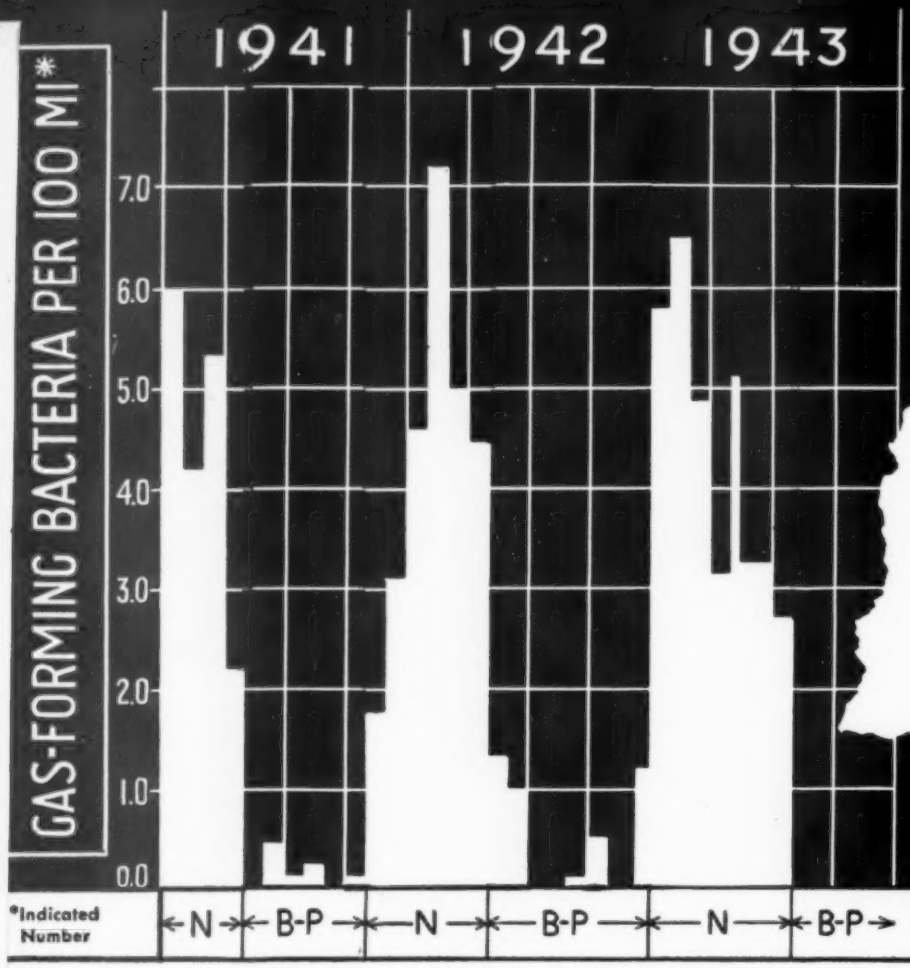

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